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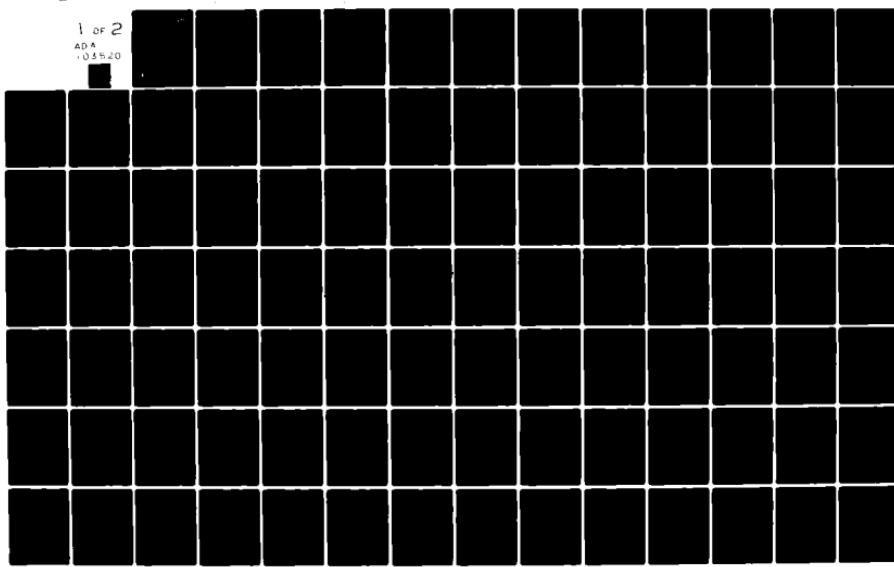
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LEHIGH RIVER BASIN

TREXLER LAKE

JORDAN CREEK
PENNSYLVANIA

FINAL
ENVIRONMENTAL
IMPACT
STATEMENT

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

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FINAL

TREXLER LAKE

JORDAN CREEK, PENNSYLVANIA

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U. S. ARMY ENGINEER DISTRICT, PHILADELPHIA
PHILADELPHIA, PENNSYLVANIA

1973

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(X) FINAL

ENVIRONMENTAL STATEMENT

TREXLER LAKE

JORDAN CREEK,

PENNSYLVANIA

SUMMARY

RESPONSIBLE OFFICE: U. S. ARMY ENGINEER DISTRICT, PHILADELPHIA, PENNSYLVANIA

1. Name of Action: (X) Administrative () Legislative

2. Description of Action. The Trexler project is located in Lehigh County in southeastern Pennsylvania. The dam site is located on Jordan Creek about seven and one-half miles northwest of the City of Allentown, Pennsylvania.

The proposed development recommends an earth and rockfill embankment 130 feet high at the maximum section with a crest length of 820 feet. The lake would have a surface area of 1,220 acres and extend about 8.6 miles upstream when filled to the top of the conservation pool. Other principal items include the relocation of approximately 3.4 miles of roads, as well as power and telephone lines. The recreation plan includes four public access recreation areas along the lake. Sewage collection and treatment will be provided as part of the recreation facilities.

3a. Environmental Impacts. The project will modify the environmental setting by creating a lake to provide for supplies of water, flood control and recreation by means of an earth and rockfill embankment. Implementation of the project will require relocation of roads, electric lines and telephone lines. Four recreation areas will be provided. Fluctuation of the pool level for storage and release will cause some shoreline exposure. Adverse effects of fluctuation will be minimized by construction features. Shallow waters in the tributaries may produce algae. Wildlife displaced by the lake will find new habitat in mitigation lands. Clearing operations and construction scars will be minimized by reforestation and landscaping. The project will assist in maintaining the water table in surrounding areas. The lake will attract and provide habitat for waterfowl from the nearby North American Flyway and introduce the potential for an expanded fishery. It is expected that the project will influence the regional economy by providing a nucleus around which new residential and commercial interests will locate and from which existing commercial enterprises can expand their public exposure.

3b. Adverse Environmental Effects. The impoundment will convert 8.6 miles of free-flowing stream to slack water. The aesthetic and intrinsic characteristics of the rural valley will be modified. Productive farmland will be lost, tax ratable lands will be removed from the county rolls, natural wildlife habitat will be eliminated and 50% of Lowhill Township will be acquired for the project. The spillway will create a large land cut readily observable from the Trexler Game Preserve and project overlooks. The location of the spillway limits expansion of the Game Preserve and confines multiple Federal and non-Federal uses to the narrow tip of the peninsula. The full effect of natural flushing and cleansing occasioned by seasonal high flows will be reduced.

4. Alternatives. Four alternatives were considered.

- a. No development.
- b. An alternate project located elsewhere to serve the same purposes of this project.
- c. A series of small reservoirs throughout the Jordan Creek Basin.
- d. Regulation of flood plain development and development of local protection.

5. Comments Requested.

Commonwealth of Pennsylvania
Department of Environmental Resources

Environmental Protection Agency
Region III

Joint Planning Commission
Lehigh/Northampton Counties

Lehigh County Authority

Lehigh River Restoration Association

U. S. Department of Health, Education,
and Welfare

U. S. Department of Agriculture
Agricultural Stabilization and
Research Service

Delaware River Basin Commission

Federation of Sportsmen's Clubs
in Lehigh County

Lehigh County Agricultural and
Home Economics Extension Association

Lehigh County Soil and Water
Conservation District

U. S. Department of the Interior
Bureau of Sport Fisheries and Wildlife

Pennsylvania State Planning Board

U. S. Department of Agriculture
Soil Conservation Service
(Administrator)

U. S. Department of Agriculture
Soil Conservation Service
Regional Technical Service Center

U. S. Department of the Interior
Office of Environmental Project Review

U. S. Department of Housing and Urban
Development
Regional Administrator, Region III

U. S. Department of the Interior
Bureau of Outdoor Recreation

6. Draft Statement to CEQ 28 July 1972.

7. Final Statement to CEQ _____.

U. S. Department of Agriculture
Soil Conservation Service
State Conservationist (Pennsylvania)

U. S. Department of Housing and
Urban Development
Assistant Secretary for Community
Planning and Management

Regional Federal Highway Administrator
Region II

TREXLER LAKE

LEHIGH RIVER BASIN, JORDAN CREEK, PENNSYLVANIA

FINAL ENVIRONMENTAL IMPACT STATEMENT

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TREXLER LAKE
JORDAN CREEK, LEHIGH COUNTY, PENNSYLVANIA
FINAL ENVIRONMENTAL IMPACT STATEMENT

1. Project Description

a. Authority. The Trexler Lake project is a major element of the comprehensive plan for the development of water resources of the Delaware River Basin, as set forth in House Document No. 522, 87th Congress, 2d Session. The comprehensive plan, approved by the Flood Control Act of 1962, Public Law 87-874, 87th Congress, dated 23 October 1962, authorized the Federal construction of eight major projects to aid in providing for the planned Delaware River Basin water resources development by the year 2010.

b. Location. The project is located on the Jordan Creek in Lehigh County 1/, southeastern Pennsylvania, approximately 50 and 7-1/2 air miles northwest of Philadelphia and Allentown, Pennsylvania, respectively. The dam site is located 12 miles above the confluence of the Jordan Creek with the Lehigh River. Schnecksville is the closest village to the dam-site, a distance of 1-1/2 miles to the northeast.

c. Major Project Features. The proposed project development is an earth and rockfill embankment 130 feet high at the maximum section, with a crest length of 820 feet. The embankment will contain 965,000 cubic yards of material.

A planned 200 foot wide spillway is to be excavated through the ridge on the right abutment at an elevation of 504 feet. The spillway will not contain any control gates, as its use will be necessitated only in the case of the once in a hundred year predicted flood. The spillway design flood requires a discharge capability of 25,400 cfs at a pool elevation of 516 feet mean sea level. The area of the summer conservation pool (elevation 497) is 1311 acres and will have a shoreline of approximately 40 miles. The area of the flood control pool (elevation 504) covers 1481 acres and will have a shoreline of 47 miles.

The outlet works will consist of a gated intake structure, outlet conduit and stilling basin. The outlet will be capable of discharging about 2,630 cfs at pool elevation 504. A multilevel withdrawal system for water supply has been incorporated in the design of the outlet works at the request of the Delaware River Basin Commission. The withdrawal system will provide for downstream releases. Pool level will be maintained as nearly as possible at the top of the conservation pool.

1/ Location map of project area - Figures 1-1 and 1-1(a), pp. 9-3 and 9-4.

There is no planned hydroelectric power development at Trexler Lake. In the view of the Federal Power Commission "the relatively small power potential associated with the Trexler multipurpose reservoir project would not be economically feasible for development" 2/. Also, in analyzing the topography around the perimeter of the reservoir, there appears to be no feasible location for the development of a pumped storage power facility.

Real estate acquisition totaling 4,432 acres will be required for the lake project and its recreation and wildlife mitigation features. Other principal items include the relocation of power lines, telephone lines and approximately 3.4 miles of roads.

d. Lake and Planned Recreation Facility. The length of Trexler Reservoir will be about 8.1 miles when filled to the normal conservation pool of 493 feet, m.s.l. The lake will expand to 8.6 miles when filled to the flood control pool of 504 feet m.s.l. The normal conservation pool will have a surface area of 1220 acres and a total volume of 41,010 acre feet. The greatest width of the lake under normal conditions will be 2000 feet with an average width of less than 1000 feet. The average depth of the reservoir will be 50 feet.

Along the shores of the reservoir four recreation areas will be developed to provide picnicking, camping, hiking, hunting, fishing, boating, and sightseeing; a visitor center will be provided at the dam site. Pending the results of further water quality studies being conducted presently in coordination with the Environmental Protection Agency and the Commonwealth of Pennsylvania, it appears that swimming and other water contact sports will also be included in the recreation plan. Access into passive areas are via internal roads and controls will be provided to eliminate traffic congestion; one of the factors used in determining the annual use rate considers the ability of the land to absorb visitors. Trash and litter will be removed on a daily basis from the recreational areas.

It is Corps policy to maximize the aesthetic value of a natural setting in the development of all recreation sites. Also sewage facilities will be provided at all the planned recreation areas. The environmental impacts of the proposed recreational facilities at Trexler Lake will be discussed in more detail in Section 3 of this document. An expected ultimate visitation of 424,500 visitors annually is planned with a daily design load of 5,754 visitors, which includes swimming, fishing, boating, picnicking, hiking and playground activities. In addition to the planned Corps of Engineers recreation facilities, the development of the Trexler Game preserve by Lehigh-Northampton Counties is planned to accommodate 350,000 visitors annually.

2/ FPC letter of 21 April 1966.

e. Proposed Lake Operating Program. The drainage area of Jordan Creek upstream from the proposed dam is 52.0 square miles. Water will be impounded in Trexler Reservoir during periods of high runoff to reduce the downstream flood stage at Allentown. During other flow periods, releases will be regulated in order to maximize the water resource benefits of the lake without hindering downstream flow requirements. Controlled release rates will vary between 5 cfs during normal flow periods to a maximum of 2000 cfs in periods of flood flow. The safe downstream channel capacity of Jordan Creek is determined to be 2000 cfs.

The operating rule curve 3/ for the Trexler Lake indicates maintenance of a normal conservation pool elevation of 493 feet m.s.l. until 22 March. For the time period of 22 April through 16 July, the volume of the lake will be increased an additional 4,960 acre feet to elevation 497 feet m.s.l. The summer pool elevation will then be decreased again to 493 feet by 15 August to provide for maximum flood control storage during the primary hurricane season. The principle behind the operating rule curve is that of storing water during the normally high spring runoff period for continued use during the usually dry summer period through August.

Because rainfall and runoff are uncontrollable events, one hundred percent adherence to the operating rule curve cannot be expected. The development of any hydrological model for prediction purposes is based on past data. The reliability of attaining expected pool elevation levels, when compared to past flow data of Jordan Creek, can be predicted with a degree of certainty. The minimum daily pool elevation probabilities presented on a monthly basis 4/ allows prediction of the percent of occurrence of certain pool elevations. The prediction is that the actual pool elevation will be equal to or less than the stated elevation.

f. Proposed Storage Pool Allocation. Storage allocation of the pool volume is determined according to project purposes 5/. The parameters and characteristics of the various allocation pools are summarized in the chart following this section.

The inactive pool volume of 1020 acre feet is reserved for expected sediment accumulation in the reservoir over a 100 year period. In comparison to other streams in the country, the Jordan Creek carries a comparatively low sediment load. Provision for sediment disposal will be explained in section three of this document.

3/ Operating Rule Curve - Figure 1-2, p. 9-5.

4/ Minimum Daily Pool Elevation Probabilities by Months - Figure 1-3, p. 9-6

5/ Diagram of Cross Section of Lake - Figure 1-4, p. 9-7

The normal and summer conservation pools provide for recreation, water supply, and flood control.

TABLE 1-1
STORAGE POOLS

	Elevation in Feet above m.s.l.	Surface area (acres)	Volume (acre feet)	Cumulative Storage (acre ft.)
Stream- bed	390	-	-	-
Top of in- active pool	420	99	1,020	1,020
Top of nor- mal pool	493	1,217	39,990	41,010
(a) Top of summer pool (22 Apr - 22 Jul)	497	1,311	44,950	45,970
Top of flood control pool	504	1,481	14,580	55,590
Top elev - tion of dam	521			

g. Flood Control Features of Trexler Lake. The top of the flood control pool is 504 feet above m.s.l. The spillway cut is at this elevation, and use of the spillway is a once in a hundred year occurrence. Trexler Lake has a storage capacity above the normal pool to hold back 4.7 billion gallons of flood waters. The 14,580 acre-feet of flood water storage capacity at Trexler Lake was formulated in conjunction with the flood control capabilities of the Aquashicola Project and Francis E. Walter Project as an integral unit in the Delaware River Basin Plan.

The record flood occurred on 19 August 1955 and would have produced a peak discharge of 9,520 cfs at the dam site. During this flood period, the flood control pool at Trexler (14,580 acre-feet capacity) would have been only 33.7 percent utilized. Table 1-1 identifies the five times over past history that the flood control pool at Trexler would have been used. The chart also identifies the percentage of the flood control pool which would have been encroached in each of the five periods.

h. Water Supply Benefits Derived from Trexler Lake. The Delaware River Basin Commission is the regulatory agency responsible for meeting the water supply needs of the area. Estimates of future water needs from the Office of Commissioners of Lehigh County in 1969 reflected a need for up to 41 million gallons of water per day by 1978. Trexler Lake's 39,990 acre-feet of water supply storage will provide up to 88% of these projected water needs of Lehigh County. Water users in the area will have to contract with the Delaware River Basin Commission, as it is the commission's legal responsibility to allocate the water. DRBC is also responsible for water sales to customers coming directly to the Trexler Reservoir. Refer to chart 1-1.

The original plan of the Trexler Reservoir Project allocated 24,200 acre-feet of water supply storage. However, after considering the 1960-1967 drought period experienced by the area, the water supply storage capacity was increased to a 39,990 acre-feet allocation. This expanded water supply allocation pool will assume 72% of the total reservoir volume. The maximum yield of the reservoir is 60 cfs and this can be met with a 98% degree of success.

Preliminary coliform tests taken in 1968 suggests that a possible water quality problem is present in Jordan Creek. However, the DRBC has contracted for the water supply from Trexler Reservoir and has indicated that the drinking water will meet acceptable quality standards. Through modern filtration and purification techniques, DRBC feels that providing water of high quality to users will not present any problem. DRBC and the Pennsylvania Department of Environmental Resources agreed on water quality standards for Jordan Creek and its tributaries. Such standards will be enforced by these agencies considering industrial, domestic and agricultural discharges into the stream.

i. Drawdown. In the course of an average year's operating cycle as predicted by the before-mentioned hydrology model 6/, drawdown of the lake would total 7-1/2 feet. However, the drawdown could be as little as 4 feet (10% probability) or in unusual circumstances as much as 77 feet (1% probability). Comparative annual drawdown figures for other reservoirs nationwide are given in Table 1-2.

During the fourteen weeks of prime summer recreation season (1 June - 15 September), the average annual drawdown is 5-1/2 feet, or less than 3/4 inch per day. However, there is a 10% probability of a recreation season drawdown of 23 feet. The pool elevation during September, for this once in ten year drawdown occurrence, is predicted to be 470 feet above m.s.l. To provide for recreation during extreme drawdown conditions, all bathing beaches and boat launching ramps will be designed to accommodate pool levels to 464 feet above m.s.l.

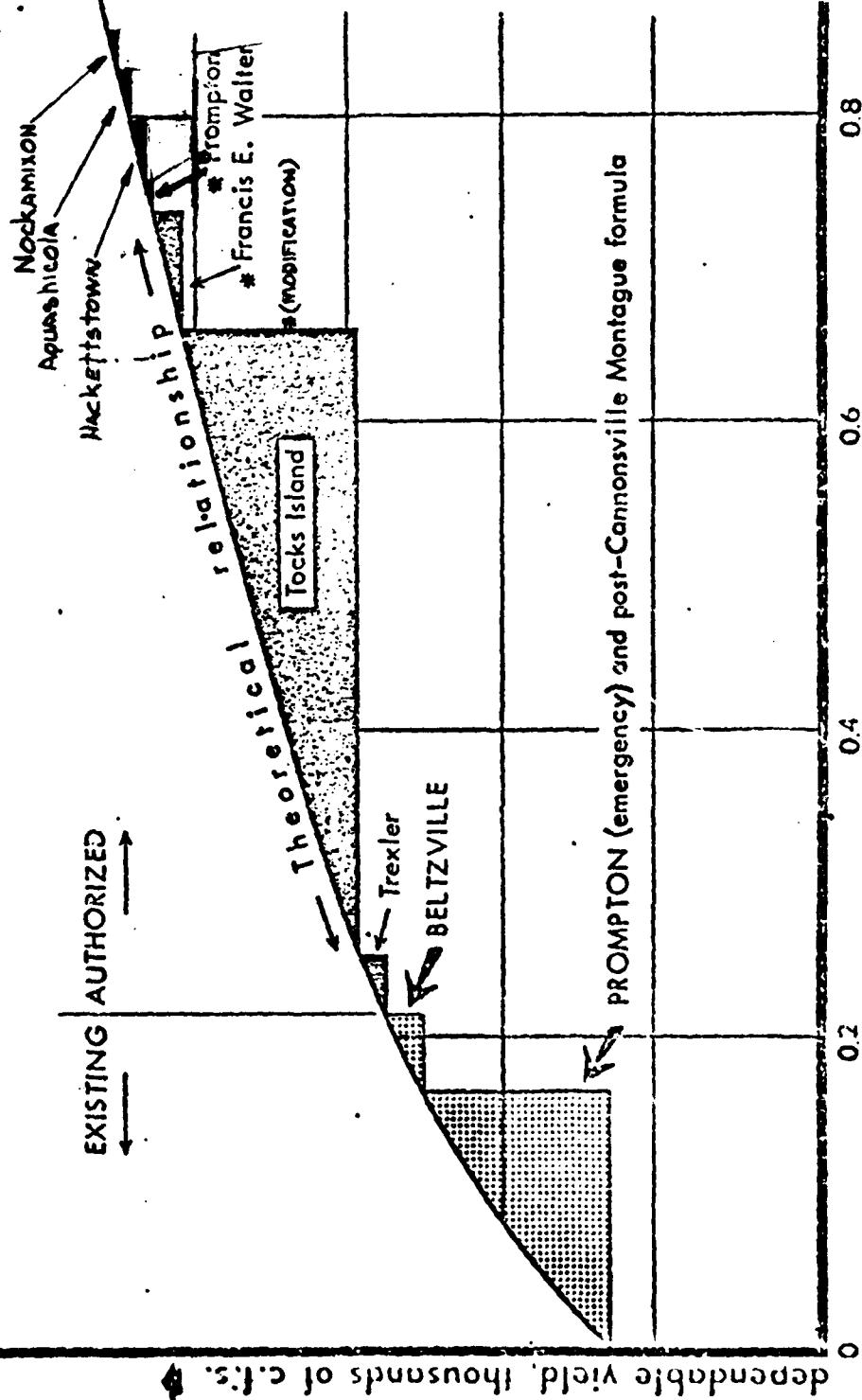
6/ As presented in Design Memorandum 2a.

CHART 1-1

DEPENDABLE WATER YIELD AT TRENTON AS A FUNCTION OF AUTHORIZED POST-1965 RESERVOIR STORAGE CAPACITY TO BE ADDED

post-1965 storage capacity, millions of acre-feet

The chart shows graphically the dependable yield that will be available from the Delaware River Basin above Trenton as a result of authorized additions to the storage capacity for supplies of water, assuming that all capacity added after 1965, except Cannonsville Reservoir, is operated to provide maximum augmentation of flows in the Delaware at Trenton. The contribution of the Trexler Lake project is noted on the chart.



j. Fishery and Wildlife Program. Boating allowed in Trexler Lake will be zoned to provide for minimal disturbance to the aquatic ecosystem that will develop in the lake. Fishing will be permitted throughout the entire lake from either bank or boat access. A fishery management program will be developed by the Pennsylvania Fish Commission. There will be 548 acres set aside for wildlife mitigation lands in the peninsula area bounded by Mill Creek and the Jordan Creek.

The location of the mitigation lands 7/ is adjacent to existing state game lands. A wildlife management program for these areas will be conducted by the Pennsylvania Game Commission. The project is also adjacent to the county-operated Trexler Game Preserve. A planned expansion of this facility will eventually provide an animal zoo large enough to accommodate 350,000 visitors annually.

k. Reservoir Clearing Operations. Clearing operations, as presently planned, will extend downward from elevation 507 feet above m.s.l. to the streambed. This will permit generally obstruction-free recreational use of the lake, maintain lake water quality potential, avoid a potential nutrient source which would cause a eutrophic condition, and minimize the maintenance of the lake. All vegetative growth from elevation 500 downward will be cut and removed to a maximum of 6 inches above the ground. Stumps and tree roots will not be removed, since this process would result in loose soil and extensive erosion, causing a serious siltation problem. Any floatable structures will be excavated two feet below grade and then the excavations will be backfilled and graded. All highway guard rails, debris and downed timbers will be removed. Clearing contractors will be required to clean and backfill all cesspools and septic tanks. Complete clearing will also be required from elevation 500 to 507 feet; however, tree excavation will be avoided in this area in order to maximize recreation and aesthetic benefits.

To avoid wasting the project's resources, all structures and usable timbers will be sold for salvage. Pertaining to structures, the previous owners will have priority to the salvage rights. All unusable accumulated material, such as brush from clearing operations, will be disposed of by the clearing contractor in the most economical manner consistent with applicable laws. The clearing contractor is bound to all applicable Federal, State, and local legislation pertaining to air quality and waste disposal practices.

1. Current Project Status and Benefit/Cost Ratio. The Project is presently in the pre-construction planning stage. Real estate acquisition is dependent on availability of funds. The project construction should span a three year time period.

7/ Map of Trexler Reservoir Recreation Areas -- Figure 3-1, p. 9-12.

The project cost estimate 7a/ at July 1971 price levels totals \$20,700,000. Of this amount, \$8,835,000 are Federal costs and \$11,865,000 are non-Federal 8/. The Appropriations Bill of 1972 provides for \$158,900 in funds for the continuation of pre-construction planning at Trexler.

The current benefit/cost ratio for the project is 1.6 to 1.0. This B/C ratio is based on a discount rate of 3-1/4%, which is consistent with accepted policy of the Water Resources Council. If the project were discounted at the 5-1/2% rate applicable to projects currently being justified, the benefit/cost ratio would be 1.3 to 1.0. Recreation benefits used in computing the above benefit/cost ratios have been limited to those accruing from direct use of Trexler Lake project lands and waters only. In accordance with Senate Document 97, the recreation visitor-day value is estimated to be \$1.35. This is the figure used to compute the recreation benefits credited to the project 8a/.

- 7a/ Project document costs appropriately escalated are reported herein.
- 8/ The non-Federal costs include reimbursable costs for water supply.
- 8a/ A percentage breakdown of the allocated benefits derived from the Trexler Lake Project are: Recreation 21%, Water Supply 62%, Flood Control 17%.

2. Environmental Setting Without the Project

2.1 Lehigh River and its Tributaries. The Lehigh River, with a total drainage area of 1,370 square miles, is a major tributary of the Delaware River. Rising in the Pocono Plateau of Wayne County, it drains portions of nine northeastern Pennsylvania counties. Above the Lehigh Gap, the Lehigh River flows swiftly through high bordering hills. Below the Lehigh Gap, the fall of the river is more gradual. Above the City of Allentown, the average slope of the river is 6.5 feet per mile. Below Allentown to the City of Easton, the Lehigh River loses 68 feet in elevation in 16.5 miles of length for an average slope of 4.0 feet per mile.

The Lehigh River passes through four distinct water quality zones along the path from its headwaters to its confluence with the Delaware River at Easton, Pennsylvania. An inclosed map (Figure 1-5) identifies the various water quality zones of the river. The Lehigh River clean water zone runs from the headwaters to a point four miles downriver from White Haven, Pennsylvania. This area supports a high fishery population. For the next 45 miles the water quality of the Lehigh River is compromised by acid mine drainage. Because of the resulting low pH (4.0 - 5.0) in this stretch of the river, there is practically no fish population. Starting at the northern boundary of Lehigh-Northampton Counties and extending to the Allentown vicinity, the Lehigh River benefits from a recovery area. In this region, alkaline tributaries of the Lehigh River neutralize its acidic condition. The pH becomes neutral (7.0) by Northampton Borough. Biota and fish food organisms are again prevalent, to the extent that anadromous fish species (shad) can pass through the waters. The water quality of the Lehigh River declines again, however, from Allentown to its confluence with the Delaware River. The water quality in this region undergoes serious chemical and biological degradation from industrial and domestic waste.

The Lehigh River flows through the City of Allentown in a horseshoe-shaped fashion toward the south, winding its way around to the northeast toward Easton, Pennsylvania. Jordan Creek, with a drainage area of 81.0 square miles, flows generally toward the southeast, emptying into Little Lehigh Creek a short distance from the confluence with the Lehigh River. A map (Figure 1-6) depicts the confluence area of the Little Lehigh Creek and Jordan Creek with the Lehigh River.

2.2 Jordan Creek

a. General Description of Jordan Creek. The 81.0 ~~mile~~ drainage basin of Jordan Creek lies within the Appalachian Valley and Ridge physiographic province. This area is characterized by alternating ridges and narrow valleys which trend northeast-southwest. Topography ranges in elevation from 260 feet at the mouth of the stream

in Allentown to about 390 feet in the stream bed at the dam site and to about 1500 feet in the headwaters. The basin above the dam site is characterized primarily by agricultural and forest land. Jordan Creek is an incised meandering stream with narrow flood plains and a gradient of approximately 9.2 feet per mile. Rapids are present where the bedrock is exposed in the stream bed. A terrace with an average elevation of 440 feet is located in the eastern portions of the project area on the inside of the meander of Jordan Creek. These associated features suggest that Jordan Creek has been rejuvenated at least once, and is now in the early mature stage of development.

The confluence of Jordan Creek and the Lehigh River is in Allentown, Pennsylvania. Under normal conditions, the backwater influence of the Lehigh River on Jordan Creek is approximately 2000 feet above the mouth of the creek.

b. Hydrology. The average annual runoff at the gauging station 9/ on Jordan Creek near Allentown averages 18.6 inches for the twenty-four years of data (1944-1968). The mean daily discharge flow at this location is 70 cfs which is equivalent to 18.2 inches of runoff. The average monthly flows at Allentown have varied from 383 cfs in March of 1953 to 1.2 cfs in July 1966. The average daily flows at the gauge have varied from 9,520 cfs on 19 August 1955 to 0.2 cfs on 19-20 September 1965. A flow of 200 cfs or greater is experienced at Allentown 15% of the time. However, 35% of the time a flow of less than 50 cfs is present, while 9% of the time 10 cfs or less is experienced. The 7 day - 10 year low flow frequency is 2.2 cfs.

The mean runoff as a percent of mean precipitation is greater than 60% for the months December through April. The peak percentage is 90.9% of precipitation going to runoff for March. The percentage is 26% or below for the months June through October, with July representing the lowest runoff to precipitation rate of 19.3%.

c. The Geology of Jordan Creek and the Related Water Loss Problem.

Above the proposed dam site, the Jordan Creek flows across the Martinsburg formation where underflow and water loss are negligible. However, downstream from the proposed dam site between Kernsville and Allentown, the Jordan Creek's gravel belt is underlain with extensive beds of Cambrian and Ordovician limestone and dolomite. Limestones are dense, hard, brittle and soluble. Subsurface channels have been dissolved out along

9/ Map of Lehigh River and Jordan Creek Confluence -- Figure 2-7, p.9-10.

existing fractures by percolating water charged with CO₂. As Jordan Creek meanders across this permeable carbonate rock region, a definite water loss condition exists at various sections of the channel.

Loss of streamflow to underlying carbonate rocks has caused portions of the lower reach of the Jordan Creek to become dry on an average of once in three years, as reported by the USGS. The magnitude of loss is roughly proportional to the flow passing over the water-losing reach, with the largest losses occurring at the highest flow stages. The USGS has estimated that there is generally a 10% loss of water in Jordan Creek due to the sink hole conditions. According to a USGS survey, an average annual water loss of 26 cfs occurs from Jordan Creek. The amount of water loss in the downstream reaches is considerably higher than the average during periods of high flows when the creek overflows its banks onto the flood plain. During these periods, losses as high as 100 cfs have been measured.

A major portion of the groundwater outflow leaves the Jordan Creek basin by flowing northeast through an underground aquifer system before emptying into the Lehigh River. This water lost through underlain carbonate rock assumes a basic nature and aids in neutralizing the acidic nature of the Lehigh River at the confluence of the aquifer with the river. A USGS report states, "One of the more noticeable features on the water level map is the elongated depression in the water table that extends from Orefield (near Stetlersville gauge) to the Lehigh River. This trough suggests the pressure of large fractures in the carbonate rock aquifer that readily transmit underflow from the Jordan Creek. An average ground water flow of 17 mgd from Jordan Creek Basin is transmitted to the Lehigh River through these fractures." 10/

Additional water loss from the Jordan Creek streambed occurs through seepage into the underground water table. Seasonal fluctuations of ground water in carbonate rocks are usually less than 20 feet. However, the 1960 - 1966 drought period caused groundwater levels to be below normal for several successive years. Conversely, due to the water loss characteristics of Jordan Creek, the groundwater table will rise rapidly in response to an initially high rate of recharge from high runoff. As this recharging of the groundwater table nears completion, the rate of channel loss diminishes. Although channel losses generally increase proportionately with higher stream flows, during prolonged periods of high runoff the net channel losses can become negligible.

In portions of Jordan Creek, as the groundwater level falls below the stream channel, surface runoff seeps into the permeable channel beds at a rate that is sufficient to possibly cause dryness in portions of the main stream channel. Much of this lost stream flow then re-enters

10/ U.S. Geological Survey, Water Resources of Lehigh County, Pennsylvania, Woods, Charles R., Flippo, Herbert N., Lescinsky, Joseph B., p. 240, 1973

Jordan Creek downstream via springs, chiefly in the 4th Street, Helfrich's Spring Area of Allentown. The reach of Jordan Creek from Kernsville to Allentown 11/ can be generally classified into two water losing and two water gaining segments. Streamflow records collected by the USGS show the following general distribution of water gains and losses along the channel.

Kernsville to Guthsville	stream loses water
Guthsville to Statlersville.	stream gains water
Statlersville to Scherersville	stream loses water
Scherersville to Allentown	stream gains water

The downstream reach of the Jordan Creek streambed consists of deep gravel beds underlain with limestone and dolomite. In drought conditions, the normal saturated condition of the gravel beds does not exist as the water table is lowered into the limestone and dolomite region. Therefore, along certain surface portions that occasionally go dry in drought periods, Jordan Creek has actually assumed the characteristics of an underground stream with water flowing in the underground carbonate-rock region. This underground flow eventually resurfaces downstream in the Helfrich's Spring area.

Supplementing the natural flow of water in Jordan Creek are major discharges from two industrial concerns. Trojan U. S. Powder Company 12/ pumps water daily from wells (capacity of 4 mgd) for use in its manufacturing process. The company discharges a daily average of 2.0 mgd of waste water, after treatment, directly into the Jordan Creek. The Lehigh Portland Cement Company owns the Fogelsville Quarry, which is located in the vicinity of Hassen Creek. Until 1971, the quarry was in operation and as a by-product of the mining process, approximately 10 cfs of water was pumped from the quarry directly into Hassen Creek, a tributary of Jordan Creek 13/. During the ordinary quarry operation, a cone of depression in the water table surrounding the excavation is created by the continuous pumping action. In 1971 Lehigh Portland Cement Company discontinued their Fogelsville operation, and the quarry has since filled with water, eliminating the cone of depression. Although there is presently no direct pump-out of water into Hassen Creek, with the filling of the quarry the groundwater table has increased to a level where natural groundwater flow now supplements the flow of water in the adjoining Hassen and

11/ See Figure 2-7, p. 9-10.

12/ Location of Trojan Powder Company is noted on map - Figure 2-7.

13/ Location of Hassen Creek is noted on map - Figure 2-7.

Jordan Creek. This condition was indicated by the presence of a constant flow of water (7-10 MGD) in Hassen Creek during the summer of 1971, even though the direct pump-out from the quarry no longer exists.

During relatively dry summers, especially those preceded by dry springs, Jordan Creek begins to go dry in the Stetlersville area. During periods of prolonged droughts, a potential for water loss may exist over portions of the entire 10.2 mile reach of Jordan Creek from Kernsville to Allentown. When extreme drought conditions are present, a continuous dry length of the streambed can possibly extend along the eight mile reach from Guthsville to Helfrich's Spring. Portions of the Jordan Creek Stream channel were dry for up to four months annually during the severe 1963-1966 drought periods, as water was lost to the underground water table.

Normal runoff conditions prevailed in 1967 and 1968 with the return of a sufficient amount of spring and summer precipitation. As a result, Jordan Creek maintained a continuous flow throughout its entire length over this time period. This indicates that when the groundwater supply is sufficiently recharged, Jordan Creek can enjoy an uninterrupted continuous flow. However, due to a continuous loss to the Lehigh River through underground aquifers, there is always a degree of water loss in the Creek. In the normal water losing regions of Jordan Creek, the flow did reach a minimum of 7 cfs in the late summers of even the normal runoff years of 1968-1969.

In summary, the rate of water loss from various reaches of Jordan Creek is primarily a result of local geological conditions. The existing deep gravel bed of Jordan Creek which is underlain with permeable carbonate rock, in conjunction with the general level and slope of the local water table, are the deciding factors in the extent of water loss. Also the flow stage of the creek is generally a factor in the amount of water loss, with more water loss occurring at higher flow stages.

d. Existing and Planned Recreation Sites Along Jordan Creek

(1) Jordan Creek Park -

A general recreation park now exists along the banks of the Jordan Creek in Allentown from 4th Street to U. S. Route 22. A Federal grant has been obtained from HUD for extension of the Jordan Park from its present limit at U. S. Route 22 to Schererville 14/. Acquisition plans are presently being initiated for this extension. Also the Township of South Whitehall has received a HUD grant for acquisition of a municipal park along Jordan Creek between Guth's Covered Bridge and Wehr's Covered Bridge. In addition, the County has planned for 1974 an acquisition program for all of the remaining land along the banks of Jordan Creek up to and including the Game Preserve, and has requested Federal aid for this

14/ Map of Existing Recreation Areas - Figure 2-8, p. 9-11.

completion of the Jordan Creek Park. The park generally will extend approximately 200 feet from the stream banks; however, in the steeper bank section, the acquisition could total up to 500 feet back from the stream. Certain sections of the Jordan Park (denoted on the map) and Trexler Game Preserve are areas where expanded acquisition has provided more land for recreation facilities.

(2) State Game Lands -

The Pennsylvania State Game Commission manages 1300 acres of land on the north branch of Jordan Creek 15/. The game land, which is available to the public for hunting at no charge, presently supports 40,000 hunter days annually. Pheasant, Cottontail Rabbit and Woodchuck provide 65% of this game land's hunting opportunity. Also among the area's wildlife are White Tail Deer, Squirrel, Mourning Dove, and various waterfowl. The Commonwealth of Pennsylvania has indicated their willingness to develop the Federal lands acquired in conjunction with the existing State game lands. 16/

(3) Trexler Game Preserve -

The Trexler Game Preserve is an area of 1,107 acres of county owned and operated lands. Presently, the Preserve contains an animal farm which houses bison, deer, bear, and elk, in addition to the numerous other game species which are more native to the region. While some animals are penned, most species are permitted to roam throughout the area. The entire perimeter of the preserve is enclosed by a cyclone fence. The County has planned a 339 acre expansion of the southern portion of the existing preserve at a projected cost of \$1.5 million. Also a \$1.1 million expenditure is proposed by the County in order to develop a zoo which could accommodate 350,000 visitors annually. Projected completion date for both the area expansion and zoo development is 1973-1974.

e. Water Quality

Since 1968 periodic testing of water quality parameters has been conducted by different Governmental agencies. The results of the studies generally concur; however, some conflicting results have been encountered. Generally, the Jordan Creek suffers from organic pollution from agricultural runoff and animal and human wastes. However, differing coliform counts have resulted from two water sampling programs conducted by the Commonwealth of Pennsylvania. Pending completion of these studies, no definite conclusion is presented as to the water quality of Jordan Creek for water contact sports.

15/ Op. Cit.

16/ Ibid.

In 1968, a water sampling program conducted by the Corps of Engineers and the Pennsylvania Department of Health Laboratories, Philadelphia, Pennsylvania, concluded that due to a high coliform count, the quality of water in the proposed impoundment would not be suitable for water contact sports. The total coliform counts discovered in this sampling were well in excess of the 1000 MPN per 100 ml. standard of the Commonwealth of Pennsylvania for water bathing purposes. This particular study consisted of six sampling days spaced between 7 February and 20 June 17/. The streams tested were Jordan Creek and its tributaries upstream from the proposed ~~dam~~-site location (12.0 miles from the confluence with the Lehigh River.) These coliform tests disclosed that the chief organic pollutant source was generally human waste, although in some cases the MPN of fecal streptococci was more prevalent indicating an animal waste source of pollution. The reliability of the results of this particular study may have been compromised by the short testing period analyzed (February-June). In addition, the time period encompassed by this particular program is generally characterized by high runoff. Therefore, little low-flow data was used for the derivation of conclusions from the coliform count.

The U. S. G. S. supplemented the above study by conducting a biological (macroinvertebrate collections and observations of aquatic vegetation) and chemical analysis of Jordan Creek from the approximate location of the ~~dam~~-site downstream to the Fourth Street Bridge, Allentown, Pennsylvania (mile 1.8 of Jordan Creek). This study was also conducted in 1968 during the month of September.

This time period is usually characterized by low flow conditions, when point-discharge related pollution would be the most severe. The general conclusion that the stream declines in quality below Stetlersville was confirmed by both the biological and chemical tests.

As a part of the biological analyses, a macroinvertebrate sampling of the bottom material was conducted. By surveying bottom-dwelling macrofauna, a measure as to the extent and severity of existing pollution in the stream can be gauged. The results of the Jordan Creek survey showed that the macroinvertebrate population changes from predominantly cleanwater forms at Kernsville, to clean water and facultative organisms at Stetlersville, to facultative and pollution-tolerant forms at Scherersville. This survey, therefore, indicates the degradation of water quality in the downstream reaches of Jordan Creek. In conjunction with the biological survey, aquatic vascular plants and filamentous green algae were observed as predominant features of the biota in the late summer time period of the study. Water milfoil was found at some of the stations; however, it is felt that no problem exists presently or will develop in the near future. Water milfoil may prove to be a nuisance in parts of the lake; the management program for this problem, should it arise, would involve localized spot control.

17/ Bacteria Investigation, Trexler Lake.

An interesting result of this study was the relatively low coliform count observed. The total coliform count varied from 16 MPN per 100 ml to 200 MPN per 100 ml. These counts are well within acceptable limits, and in direct conflict with the extremely high coliform counts discovered in the February-June of 1968 water sampling tests conducted by the Corps of Engineers and the Commonwealth of Pennsylvania. A possible reason for this large disparity in counts between the two tests would be that the one test was taken during a comparatively high runoff period (more agricultural and animal waste) while the other test was conducted during a comparatively low runoff period. Some consideration must be given to the different locations where the tests were conducted. The tests that produced high coliform counts were conducted upstream from the area of the U. S. G. S. tests that indicated low coliform counts. Possibly the non-point sources are upstream from the proposed dam site and lower coliform counts can be expected downstream due to the coliform die-off rates.

Dissolved oxygen (DO) and biochemical oxygen demand (BOD) tests conducted by the U. S. G. S. indicated that the Jordan Creek changes from a clean classification to a bad classification between Stetlersville and Scherersville. The data collected indicated that water quality in Jordan Creek is highly influenced by man-made wastes. Dissolved oxygen concentrations varied considerably over the reach studied. On 15 September 1968, DO concentrations above Trojan Powder plant were about 7 ppm, a desirable level. However, due to the increased BOD load from the effluent of Trojan Powder Company, an oxygen sag exists downstream from this plant with the DO level decreasing to 3.2 ppm at Scherersville. Another DO sag exists at stream mile 2.0, due to the highly organic effluent of Lehigh Valley Cooperative Dairy. The following tabulation shows DO levels at various points along Jordan Creek based on samples taken 5 September 1968:

<u>Stream Mile</u>	<u>Time Hrs</u>	<u>Description</u>	<u>Discharge DO cfs</u>	<u>(mg/l)</u>
(above mouth of Jordan Creek)				
1.8	12:00 Noon	Fourth St. Bridge	14.3	5.4
2.0	10:30 A.M.	Lehigh Valley Dairy (effluent only)	0.18	6.8
5.5	1:00 P.M.	Scherersville	7.2	3.2
7.0		Trojan Powder Company		
9.4	1:30 P.M.	(near) Stetlersville	11.0	12.0
12.2	2:15 P.M.	Hassen Cr. at mouth	14.0	10.4
12.8	2:30 P.M.	Kernsville	5.2	7.0
14.0		Trexler Dam Site		

An average BOD load of 1.9 mg/l was present above Stetlersville (stream mile 9.4). However, downstream in the more polluted zone of the creek, the BOD reading was as high as 20 mg/l.

The conclusions reached by U. S. G. S. as a result of their study were that the 6 mile reach of Jordan Creek from Kernsville (stream mile 13.0) to the Trojan Powder Company (stream mile 7.0) has water of good quality; however, at Stetlersville, the creek begins to show signs of degradation caused by the activities of man. The report contends that the lower seven miles of Jordan Creek are polluted to a high degree with the pollution load severely taxing the natural purification process of the stream during low flows. The lower two miles of Jordan Creek are severely polluted, and under low-flow conditions this reach probably cannot support any life other than the most tolerant organisms.

The U. S. G. S. also conducted chemical tests of the Jordan Creek and its tributaries. Chemical analyses of water samples from three tributaries, (Switzer, Lyon, and Mill Creeks) to Jordan Creek above Schnecksburg, just downstream of the dam site, and from various ground water wells within the basin are available for use in estimating water quality in the Trexler Reservoir. With moderately high flows in Switzer and Lyon Creeks, the total phosphates concentrations were 0.82 and 1.7 mg/l, respectively. These are considered high and are believed due to the dairy farms in the stream valleys. Phosphate concentrations at Schnecksburg are high when surface runoff is high. One sample from Mill Creek during a low flow period had a phosphate concentration of only 0.06 mg/l. Phosphate concentrations in the local ground water are relatively low, with the concentration of 0.1 mg/l exceeded in only one of six wells sampled. Tests conducted by the Commonwealth of Pennsylvania on 23 February 1972 indicate phosphate concentrations ranging from 0.05 ppm to 0.14 at the seven sampling stations observed in the damsite area. Therefore, it appears that phosphate concentrations in the stream and underground water table are relatively low except during periods of high runoff when the area's agricultural nature adds to a higher phosphate concentration in the surface streams. Several samples from the three tributaries revealed similar concentrations of nitrates, ranging from 8 to 25 mg/l. Nitrate concentrations in local ground waters are moderate.

Water quality testing is currently being done on the upstream reaches of Jordan Creek by both the Commonwealth of Pennsylvania and the Environmental Protection Agency. To date, through two sampling programs (conducted 24 June, 13 July, and 27 July 1971; 23 February 1972) the State data confirms the relatively low BOD load on the Jordan Creek above the dam site location. The average BOD load of the seven sampling stations is 1.5 mg/l. The results of tests to date also show lower coliform counts, both total and fecal, generally less than 100 MPN per 100 ml during the 23 February test sample. However, the coliform counts were much higher during the June and July tests, exhibiting values between 50 MPN per 100 ml to 490 MPN per 100 ml. Both sets of data are in direct contrast to the tests conducted in 1968 by the Corps of Engineers and the State of Pennsylvania, where coliform counts were generally from 5,000 MPN per 100 ml to 25,000 MPN per 100 ml. The most recent tests by the State now indicate that there is not as much contamination in the upstream reaches of Jordan Creek as was originally believed. The Corps of Engineers is continuing water quality sampling on the upper reaches of Jordan Creek.

f. Fishery Characteristics of Jordan Creek. Jordan Creek generally has water of sufficient quality to support a diversified fish population in its upstream reaches. In the lower reaches of the Creek, water quality degradation and periodic dry areas seriously hinder the fishery potential. In time of low flow, the dissolved oxygen levels below Scherersville can become too low to support a diversified fish population.

According to the Pennsylvania Fish Commission, Jordan Creek is classified as a warm water fishery along most of its headwater regions. The headwater regions of the Jordan Creek support a good to high quality of fishery. The Creek, in its lower region, deepens for a 1-1/2 mile stretch and is fed by cold spring water. In this specific area of deeper and cooler water between Helfrich's Spring and the northern end of the existing Jordan Park in Allentown, the Pennsylvania Fish Commission stocks about 5,000 brown trout annually between the months of March and May. Further downstream toward the Jordan Creek's confluence with the Lehigh, the stream once again becomes a warm water fishery. Because of existing pollution loads on this lower region of Jordan Creek, the fishery resource potential of this portion of the stream is greatly reduced.

The creeks within the proposed project area support a warm water fishery of moderate to high quality. Creeks in this region are generally alkaline in nature. Generally, the more alkaline the stream, the better the fishing, as alkaline conditions promote more fertile conditions for vegetative growths which the fishlife can feed on. An inventory of the existing fishlife in the vicinity of the dam site was obtained from four sampling stations observed by the Pennsylvania Fish Commission. The pH readings at these four stations ranged from 7.5 to 8.2, verifying the stream's alkaline characteristics in this region. The types of fish observed are presented in Table 2-1. None of these fish are anadromous.

2.3. General Project Area

a. Population and Land Use Trends — Lehigh-Northampton Counties
Lehigh and Northampton counties, centering on the cities of Allentown and Bethlehem, are located in eastern Pennsylvania, 90 miles southwest of New York City and 50 miles northwest of Philadelphia. The area is a dominant part of the region defined as the Lehigh Valley. The U. S. Bureau of Census evaluates the Lehigh Valley by the Allentown-Bethlehem-Easton Standard Metropolitan Statistical Area (ABE-SMSA). This statistical area is the third largest in Pennsylvania, with only the Philadelphia and Pittsburgh areas being larger.

When the Lehigh Valley region is considered with regard to the surrounding eastern seaboard states, the central location of the area becomes evident. The region lies near the center of the megalopolis that is rapidly forming from southern New Hampshire to northern Virginia. The Lehigh Valley is located within 250 miles of a majority of the large

TABLE 2-1
 TYPES OF FISHLIFE IN THE VICINITY OF TREXLER DAMSITE
 (Source: Pennsylvania Fish Commission)

<u>Common name</u>	<u>Scientific name</u>
Brown trout	<u>Salmo trutta</u>
Smallmouth Bass	<u>Micropterus dolomieu</u>
Largemouth Bass	<u>Micropterus salmoides</u>
Bluegill	<u>Lepomis macrachirus</u>
Redbreast Sunfish	<u>Lepomis auritus</u>
Pumpkinseed	<u>Lepomis gibbosus</u>
Rock Bass	<u>Ambloplites rupestris</u>
Redfin Pickerel	<u>Esox americanus americanus</u>
American Eel	<u>Anguilla rostrata</u>
Carp	<u>Cyprinus carpio</u>
White Sucker	<u>Catostomus commersoni</u>
Fallfish	<u>Semotilus corporalis</u>
Creek Chub	<u>Semotilus atromaculatus</u>
Shield Darter	<u>Percina peltata</u>
Johnny Darter	<u>Etheostoma nigrum</u>
Rosyface Shiner	<u>Notropis rubellus</u>
Spottail Shiner	<u>Notropis hudsonius</u>
Sporfin Shiner	<u>Notropis spilopterus</u>
Common Shiner	<u>Notropis cornutus</u>
Blacknose Dace	<u>Rhinichthys atratulus</u>
Margined Madtom	<u>Noturus insignis</u>
Bluntnose Minnow	<u>Pimephales notatus</u>

metropolitan areas in the Eastern United States. Over 25% of the nation's population lives within a 250 mile radius of the region.

The expanding urban concentrations of New York City and Philadelphia exert a direct influence on the Allentown-Bethlehem-Easton area. Lehigh County has an excellent centralized geographic location which is reinforced by a superior highway access to external markets. This access to large markets, when coupled with the skilled labor force available in the area, provides a well-developed industrial base with great potential for future expansion. In the past 12 years, 87 new industries providing 13,700 new jobs have located in Lehigh County. This rapid industrial expansion is representative of the industrial appeal of the area and indicates the future industrial growth potential which is predictable. The county presently contains 2,250 acres of unoccupied, industrially-zoned land.

Directly related to the rapid industrial growth in the area is the decreasing of agricultural employment in the Lehigh-Northampton region. Between 1950 and 1960 as total employment in the region increased 10.6%, agricultural employment decreased 45.3% 18/. This is a substantial decrease in only ten years, and the trend appears to be continuing. The application of new technology and techniques has increased the farmer's ability to produce more products while employing less help. The typical individual farm today employs less labor, but includes more land and capital. As a result there has been a growth in the size and values of farms while a reduction in the total number of farms has occurred concurrently. Between 1950 and 1960 the number of Lehigh County farms decreased from 2,008 to 1,335, a loss of one third. Between 1960 and 1965 there was a decrease of 215 farms, or 16 per cent. The acres of farmland decreased 15 per cent during 1950-1960, but only 2 percent from 1960-1965 19/. This trend in agriculture, when viewed in light of the increased opportunities available in area industry, has caused many farmers to change their occupation. In 1950, 3.5 per cent of the two county population was employed in agriculture, while by 1960 this percentage had decreased to 1.7 per cent.

The factor of increased industrial opportunities in tandem with the region's pleasant living conditions, natural beauty, and variety of recreational advantages, provides ample reason for the area's rapid growth. Figures for 1970 indicate that 253,057 people live in Lehigh County today compared to 227,536 in 1960. This represents an 11 per cent growth factor for the decade and is in sharp contrast to the 4 per cent growth rate experienced in the State of Pennsylvania during the same time span. Composition of the present population in Lehigh County is 250,190 (99 per cent) white residents, with 2,867 (1 per cent) non-white residents.

18/ U. S. Bureau of Census, 1960 U. S. Census of Population.

19/ The Plan, report prepared by Heidelberg, Lowhill, and Weisenberg Townships Planning Commissions, September 1971.

The Joint Planning Commission of Lehigh-Northampton Counties projects a population increase of 35 per cent to 350,000 by the year 1990. Much of this expected population growth is expected to occur in the suburbs to the north, west, and south of the city of Allentown. The rapid industrialization and population growth of the area will also generate parallel growth in other segments of community life such as homes, stores, schools, shopping centers, etc. Presently, new housing developments, large industrial facilities, and schools are occurring to a significant degree in the outlying vicinity of Allentown. In addition, after formation of the proposed Trexler Lake, secondary home building on this specific area is also a possibility.

b. Population and Land Use Trends -- Tri-Township Area.

The three townships of Lowhill, Weisenberg, and Heidelberg compose the area in which Trexler Lake and its upstream tributaries are principally located. The population growth rate of 25.7 per cent (1960-1970) for this tri-Township area far exceeds the State growth rate of 4 per cent and the U. S. growth rate of 11 per cent. Presently, there are 4,271 people living in the tri-Township area, and the Joint Planning Commission of Lehigh-Northampton Counties projects a population of 5,840 for the area by 1990.

Land use in the general tri-Township area is chiefly agricultural. The total area covers 41,175 acres. By acreage, 83 per cent of the land is used for farming or orchards. The remaining acreage is distributed among parks (5.5 per cent) and residential development (3.5 per cent). There is presently only one existing industry in the area. The tri-Township's residential pattern is characterized by low population densities, medium to large size lots, and is generally occupied by structures in good condition.

The tri-Township area contains only 88 acres of commercial land or .02 per cent of the area's total acreage. The lack of commercial development can be attributed to the rural, dispersed nature of the area. Presently, the City of Allentown provides the needed goods and services for this area's residents. However, as the tri-Township area's population continues to grow, a demand for a neighborhood shopping center for the day-to-day needs of the residents could become a distinct possibility. Planned commercial centers, guided by proper land use zoning, could enhance the area's future economy and make the tri-Township area more attractive to prospective residents.

c. Water Supply Needs. In conjunction with the rapid growth of population and industry in Lehigh County, is an accompanying need for a greater availability of water. In the mid-sixties, the Lehigh County Commissioners, recognizing the need for additional water sources for the expanding population in Lehigh County, established the Lehigh County Authority for the express purpose of analyzing and securing water supply sources.

The Trexler Reservoir is a major portion of the overall plan of the authority. However, if the Trexler Project were not approved, the Lehigh County Authority would have to provide other sources of water to supply the needs of the people and industry in the area. To accomplish this, the authority has drilled and is currently drilling wells in upper Macungie Township and is contemplating a new filtering plant at Allentown. The major water sources in Lehigh County, other than Allentown, are drilled wells. Even though the quality, capacity, and health safety of private water supplies are in no way viewed favorably as public supplies, they are very often used due to economic considerations. Drought periods, possible contamination from underground seepage from septic tanks, and an ever-increasing demand on these wells which could lower the ground water table, are possible dangers that could result in a critical water shortage for both residential and industrial users.

In the Heidelberg, Lowhill, and Weisenberg tri-Township area, in which the reservoir and the upstream tributaries are located, there is no public water service. The main source of water is from individual on-lot water supplies, except for the Trout Creek Pond in Heidelberg Township. This pond currently serves the town of Slatington and might be made available for distribution to the tri-Township area.

The water need projections for this area exceed the present supply sources as the Commission of Lehigh County, in their letter of 30 June 1969 to the Army Corps of Engineers, stated:

The City of Allentown has requested by resolution, an allotment of 15 MGD; the Commissioners of South Whitehall Township have requested 11 MGD; the Supervisors of Upper Macungie Township are including in their request the industrial needs of the new industrial complex indicating a need for a minimum of 10 MGD, increasing to 15 MGD by 1978. It is clearly indicated that at this writing we have a minimum need of 41 MGD from three of the areas involved, which does not give any amount for additional areas

Lehigh County's new industrial areas also require water. New operations in this area by F. M. Schaefer Corporation and Kraft Foods already are projecting water needs upwards of 2 MGD. Their water needs will be supplied on an interim basis by a water system of wells and a reservoir. With the possible future development of 2,250 acres of unoccupied industrially-zoned land in the area, a further demand will be placed on the water supply sources of the county.

d. Climatology. The climate of the Allentown area is characterized by generally moderate temperatures and moderate amounts of precipitation. The mean annual temperature for the region is 51.7°F. Minimum temperatures during the months of December, January, and February

are usually below freezing, though infrequently falling below 0°F. The average monthly temperatures as well as the monthly maximums and minimums for the 34 year period recorded at the Allentown Gas Company and the Allentown-Bethlehem-Easton Airport are shown in Table 2-2, page 9-2. Extensive rainfall can be expected from the passing of either warm or cold fronts and an occasional hurricane. Snowfall in the project area is typical of the Delaware Basin and must be considered as a potential threat to basin flooding. Storms caused by warm fronts are most prevalent during the colder portions of the year and produce a semi-intense rainfall over a protracted time. Cold front storms are most frequent during the warmer months of the year and are characterized by thunderstorms with accompanying intense precipitation occurring over a short time interval. The average annual rainfall is 41.43 inches per year. The average annual snowfall during the period of record has been variable, ranging from 5 inches to 65 inches, with the mean snowfall at 32.8 inches annually 20/.

The area is seldom subject to destructive wind storms although tornadoes have been reported. Those records at Allentown supplemented by those at Binghamton, New York, Scranton, Pennsylvania, and Newark, New Jersey show that winds from the western quadrant occur about 40 per cent of the time. Therefore it is considered proper to assume that a northwesterly or westerly wind is the prevailing wind for the Allentown area. Although usually moderate, wind velocities of 55 miles per hour have been reported at the Allentown-Bethlehem-Easton Airport.

c. Floods and Droughts. Flooding throughout the Lehigh River Basin has resulted from either extra-tropical or tropical storms. Extra-tropical storms are divided into two general categories: those associated with the passage of a cold front or with a warm front. The majority of basin-wide floods have resulted from the semi-intense rainfall over a long period of time, usually associated with storms caused by a warm front. However, cold front storms, characterized by intense rainfall over a short period of time are usually the cause of flooding along the tributaries of the Lehigh. These tributaries, including the Jordan Creek, are primarily steeply-sloped streams without the channel capacity to handle major amounts of runoff. The Lehigh River Basin has also experienced several basin-wide floods due to hurricane storms. The record-breaking floods of August 1955 were the result of two hurricanes which passed in the vicinity of the basin within a week. The first saturated the extremely dry ground, while the second produced large runoff quantities.

Flood conditions may be further aggravated by other factors: the depth of the existing snowpack when combined with a high melt rate, ice jamming, or by a reduction in the initial and infiltration losses resulting from frozen ground. Although the records indicate that serious flooding along the Lehigh has not been attributed directly to snowmelt, the

20/ Refer to Table 2-2, p. 9-2.

accumulation of snowfall over the drainage area of the Lehigh River, including the Jordan Creek Basin, combined with spring rains and rapid warming, presents a flood threat to the Allentown area. The annual spring snowmelt, combined with a sudden ice break-up in Jordan Creek, has resulted in minor flooding in Allentown.

Very little flood stage and discharge information is available for Jordan Creek prior to the installation of the gauge at Allentown in 1944. There have been a number of seriously damaging floods in other sections of the Lehigh River Basin prior to 1944 and, probably, Jordan Creek exceeded its flood stage during these times. The maximum recorded flood was the result of hurricane "Diane" which passed near the basin in August 1955. The resulting peak stage recorded at the Allentown gauge was 8.00 feet with a corresponding discharge of 9,520 cfs. The flood of May 1942 reached a stage of about 7.1 feet which was established from high-water marks to 650 feet downstream of the gauge. Table 2-3 lists the nine highest flows recorded at the Allentown gauge.

TABLE 2-3
FLOODS OF RECORD AT ALLENTOWN
October 1944 to September 1965

Jordan Creek Gauge

<u>DATE</u>	<u>DISCHARGE (cfs)</u>
Aug 1955	9,520
Feb 1951	5,940
Feb 1965	5,720
Nov 1950	4,240
Feb 1958	4,000
Nov 1950	3,520
Sep 1958	3,280
Mar 1962	3,180
Dec 1953	3,070

The established frequency of the August 1955 flood, at the Allentown gauge, is approximately once in 45 years 21/.

The most susceptible area to flood damage during any major rainfall is the flood plain and the structures constructed on it. The flood plains within the City of Allentown include residential, commercial, and industrial development. Railroads, highways, streets, utility lines, production facilities, and a sewage treatment plant would be subjected to flooding. The flood plains of Allentown are almost fully developed and future urban expansion is not likely. However, urban expansion has and will probably continue to extend to suburban areas

21/ The discharge frequency for Jordan Creek at the Allentown gauge was determined by the methods described in the report entitled: "Statistical Methods in Hydrology," prepared by Mr. L. R. Beard.

adjacent to Allentown. There are a number of industrial firms located on or near the flood plain of Jordan Creek. Between the Fifth Street and Seventh Street Bridges, the flood plains have been developed into a park. There are three small dams on Jordan Creek within the park and two more dams upstream of the Seventh Street Bridge. The dams are all of similar construction and are the low-flow type having no storage capacity. A continuous County Park along the banks of the Jordan Creek is in the acquisition stage presently and was discussed in Section 2.2d.

The Delaware River Basin, including the Allentown area, has experienced seven extended periods of drought since 1905. The most severe drought occurred from 1961 to 1967, a duration of 68 months. An extended dry period of this length is considered very rare and has been estimated to possibly be a once in 300 year occurrence by the U. S. G. S. ^{22/}. Prior to the drought of the 1960's, the most severe dry period was 24 months. An extensive discussion of these drought periods is contained in House Document 522, 87th Congress: "Delaware River Basin, New York, New Jersey, Pennsylvania, and Delaware." The date of occurrence and duration of each drought period is shown in the following table.

TABLE 2-4
PERIODS OF DROUGHT

<u>Year</u>	<u>Months</u>	<u>Length of Drought</u>
1908	Jun-Dec	7 months
1909	Jul-Dec	6 months
1914	Feb-Dec	11 months
1930-31	Jan 30 - Dec 31	24 months
1941-42	Jan 41 - Feb 42	14 months
1957	May-Dec	8 months
1960-66	Oct 60 - May 66	68 months

f. Wildlife. A major factor which determines what areas are well-suited for wildlife habitat is terrain suitable to provide the wildlife with both mobility and protection. Proper soil conditions, abundant vegetation and water supply are key factors in determining the amount of food supply available for the area's wildlife. The soils, vegetation and water supply of the Jordan Creek Basin are generally suitable for open-land animals. Open-land species such as rabbit, woodcock, quail, ring-necked pheasant, mourning dove, bobwhite, and meadowlark are present in the rolling fields and meadows which are

^{22/} Hardison, C. H., "Probability of Allowable Yields in Delaware River Basin," U. S. G. S., Washington, D. C.

characteristic of the area. In sections of the county where forestation is abundant, woodland species such as gray squirrel, woodchuck, red and gray fox, opossum, skunk, and deer abide. Lowhill Township, the proposed area which encompasses the Trexler Lake, supports a large deer population. Grouse, waterfowl, including geese and duck, are present in the area. Jordan Creek is now a minor waterfowl habitat; however, if a lake is formed, the potential for waterfowl habitat will greatly increase.

The area also posseses some species not native to the region as a result of the Trexler Game Preserve. This county-owned and operated wildlife preserve possesses bison, deer, bear, elk, palomino, llama, staghorn deer, and many other exotic species.

The Trexler area serves as a habitat for all birds which are native to the region. There are also many species of game birds stocked at intervals at the State Game Lands by the Pennsylvania Game Commission. Great horned owls, long-eared owls, and Canadian geese have also been seen at the Game Lands.

g. General terrain, geology, and vegetation of the area. The area of the proposed project lies in the Appalachian Highland Region and is characterized by alternating ridges and narrow valleys which trend northeast-southwest. The low rounded hills and shallow valley of the Jordan Creek Basin provide a serene pastoral area setting. The area is generally in agricultural use, and spotted with widely scattered rural communities. Less than 15 per cent of the project site is naturally forested and is represented by second and third growth hardwood varieties. Approximately 10 per cent of the project area has been privately planted with conifers and apple orchards. Despite the high shale content of soils in the area, most of the land, other than the steepest slopes, has been cleared for farming and orchards.

The entire project area, above the proposed dam site is underlain with Martinsburg Formation of Ordovician Age. There are several thousand feet of sediment present varying from sandstone to shale to slate. The specific project area is generally sandy shale. The region's hillsides, underlain with Martinsburg shale formations, are symmetrically rounded near the tops of the divides and steep in slope next to the many streams cutting through the area. Much of northwestern Lehigh County has hills of this type, including one site located in the Trexler Game Preserve, southwest of Schnecksville, with an almost perfect formation of shale that is exposed to view.

The mineral resource potential of the area appears to be minimal. The project area shows no indication of possible coal fields as the rock layers in the region are older than any in which commercial coal has been discovered. There also appear to be no natural gas or oil resources in the area. Since no slate excavation is considered feasible in the project area, there appears to be no potential for a commercial quarry.

There is a fossil area in the northwest corner of Lowhill Township. This is considered as a unique geological area for Lehigh County by the Joint Planning Commission of Lehigh-Northampton Counties. The area is described in a County Publication, "Regional Recreation and Open Space Plan," as follows:

"...South of Pleasant Corners in Lowhill Township is a well known site containing numerous Brachiopods, or sea shells. The shells were deposited during the eons of time that the Lehigh Valley was covered by a large inland sea. Much of the area's existing bedrock was deposited during this period; present day topography is due to erosion of the bedrock which was uplifted after the sea retreated..."

As a matter of record, it should be noted that this type of fossil area is not considered unique, since Brachiopods or sea shells deposited during the glacial age have been discovered in many locations including the Beltzville Lake Recreation Area near Lehighton, Pennsylvania. The area discussed in the County publication is far removed from the Trexler project site.

The representative flora present in and adjacent to the Trexler Lake area are musk thistle, beard tongue, butterfly weed, and arrowwood. Some of the area's other wildflowers such as trailing arbutus, lilies, and orchids are becoming rare due to being overpicked. The second and third growth timber stands in the area consist generally of oak, red maple, yellow poplar, pine, hickory, ash, and birch. Over 70 per cent of the Lehigh County forests are privately owned, however, and are subject to the plans of private developers. In addition to natural forestation, much of the privately-held lands have been planted with conifer and fruit trees. There are no significant stands of rare plant species in the project area; however, those stands do occur in other parts of the township and are being preserved and protected by county and state agencies.

The northwest corner of the project area is endowed with sufficient elevation and clear areas that permit attractive viewing by sightseers. The Joint Planning Commission of Lehigh County considers the Lowhill Township area among its top priority open space areas due to its combination of geological, botanical, wildlife, and ornithological attributes which complement the area's terrain, forestation, water bodies and recreational values.

h. Historical. There are numerous covered bridges along Jordan Creek which add to the area's aesthetic and quaint appeal. Two examples are Rex and Geiger Covered Bridges, which are both located downstream from the proposed dam site. These two bridges were built in 1858 and are noted for their stone abutments.

There is a unique Indian bake oven located in the Trexler Game Preserve near Jordan Creek. The bake oven, which is chiseled out of solid rock, is the only one believed to have been discovered to date in Pennsylvania. Lehigh County plans to restore the oven as a shrine to the Lenni Lenape Indians.

i. Transportation Network. The general project area is serviced by a network of superhighways. Adjacent to the project, U. S. Route 22 (which connects Interstate 78) runs east-west and the Northeast Extension of the Pennsylvania Turnpike runs north-south. Route 78, which services Harrisburg to the west and New York City and Northern New Jersey to the east, is connected with Route 22 in the Allentown-Bethlehem-Easton area. U. S. Route 22 has a daily load capacity of 20,000 vehicles and is presently carrying 10,000 ~~23~~. Interstate Route 80, which services Northern Pennsylvania and New York City, runs parallel to Route 78 and approximately 30 miles north of the project site. New York State residents would have access to the area via Route 81. The Philadelphia area is within 1-1/2 hours travelling time of the Allentown area via either of two four lane highways, Route 309 or the Northeast Extension of the Pennsylvania Turnpike.

Of prime importance to any area serviced by a good network of expressways is an equally well planned group of arterial roads. The primary function of arterial roads is to connect smaller communities with the major traffic generators of the region. The project area is serviced by two arterial roads, Route ~~309~~ and Route 100. The capacity of arterial roads is designed for 5,000-10,000 vehicles per day. Presently, Route 100 carries 3,000 vehicles per day, while Route 309 handles a daily traffic load of 4,000 vehicles.

There is a sufficient network of secondary roads connecting the two main arterial roads (Route 100 and 309) with the general area of the proposed reservoir. Off Route 309, the approximate area of the dam is serviced by LR 39057, LR 39058. The Mill Creek Branch of the Lake has access from Route 309 through Township Roads 655, 667, and 672. Two of the proposed recreation areas are serviced from Route 100 by LR 39064, LR 39072, and Township Roads 596, 635, 639, 649, 692, and 684.

There is no public transportation in the general project area. Only a small portion of South Whitehall Township, directly adjacent to Allentown, is serviced by some busing. No commercial bus system serves any of the other outlying communities in the northwestern townships of Lehigh County. Allentown is provided with bus service to other major cities such as Philadelphia, New York, Harrisburg, Bethlehem, and Easton.

j. Health and Community Services. The project area does not provide any local health facilities or police protection. There are no hospitals or medical clinics in the tri-Township area or North or South Whitehall Townships. However, hospital facilities are present within approximately 10 miles in the Allentown area. Although the project area does not have a local police staff, the area is serviced by the State Police, operating out of the Fogelsville and Bethlehem Barracks.

At the present time, there are no public sewage collection systems in the townships directly adjacent to the proposed reservoir. The townships involved are Lowhill, North Whitehall, South Whitehall, Weisenberg, and Heidelberg. All homes and businesses in the area use on-lot systems, using either septic tanks or cesspools. The only exceptions are Community College in North Whitehall, which has its own small sewage treatment plant, and a one mile wide urbanized area of South Whitehall which is adjacent to Allentown and is incorporated into that city's municipal sewerage system. The Pennsylvania Department of Environmental Resources reports that the possibility of serious problems due to malfunctioning of septic tanks leading to pollution of individual wells exists. At present, Pleasant Corners and Germansville have serious problems due to percolation of sewage effluent into the groundwater table. The steep slopes of Heidelberg also pose a definite problem to the groundwater supply. Although at present it does not appear economically feasible to incorporate a municipal sewage system in the area, the county planning boards are considering some type of public sewerage system for the future 24/.

Within the five townships surrounding the proposed lake area, there are presently three municipal dumping facilities. The Novak landfill services a portion of the solid waste needs of South Whitehall Township and the western portion of North Whitehall Township. The western portion of North Whitehall Township is serviced by the Heluva Landfill. Weisenberg Township residents are permitted to use the municipal dump located on Blacksmith Road in Weisenberg Township. Private collectors cover most of the townships, but in some areas where there is no collection, other methods of garbage disposal are used. Some people use electric disposals for non-combustible and burn their combustibles. People living on farms often pile their waste away from the house, or, like many residents living on small lots, they dispose of it along the back roads. Other more conscientious citizens save their disposals until they have a sufficient amount to drive it to the North Whitehall or Weisenberg disposal facilities 25/.

24/ The Plan, Report prepared by Heidelberg, Lowhill, and Weisenberg Townships' Planning Commissions, September 1971.

25/ Ibid.

The area is planning for future waste loads as can be shown by the following statement issued in a township planning report:

"In reviewing the problem of garbage disposal in the three townships with the Pennsylvania Department of Environmental Resources, it was determined that a central collection system might be used to alleviate those problems of disposal that presently exist. This is a system whereby a 'Demsi-Dumpster' type container would be left at a central location within each Township. The residents would then take their disposables to this central point and put them in the container left there. A truck would then pick up the container and take it to the dump for disposal. This system would in all probability have to be subsidized by the Townships." 26/

26/ Op. Cit.

3. Environmental Impacts of the Proposed Action

3.1 Physical Changes Caused by the Project. Development of the Trexler Lake Project will produce substantive changes in the existing physical conditions at and around the project site. Certain changes will be associated with construction activities and thus temporary, while others are associated with the facilities constructed and their operation and consequently are permanent. The physical changes are identified in this section and their effects and significance discussed in the following paragraphs.

a. Temporary Changes. The temporary changes associated with construction will be localized to the actual areas of construction and, in those areas, change the setting from one of rural tranquility to one of relatively heavy activity. Such changes include the increased noise levels produced by construction operations, dust generated by construction activities, and hydrocarbon emissions from construction equipment. Mud and silt materials will be generated in large areas to be stripped of vegetative covers for open borrow pits. Local water table levels will be changed temporarily due to construction activity. Social factors include the temporary increase in population from introduction of transient work forces. Other changes include local and state police activity - surveillance, protection, and investigation due to increased population. Fire protection will also be required. There will be changes in traffic patterns due to detours, and increased demands on utility systems - telephone, electrical, gas, water, and sewerage. Also, beginning with initiation of real estate acquisition, an increase tax ratable will occur and may put a temporary burden on communities directly affected by the project. Lastly, the course of the stream will be altered with some wildlife displaced. A three year construction period is planned with one year required to establish the conservation pool. The wildlife species to be found are white tailed deer, cotton tails, opossum, red and gray squirrels, chipmunks, black bear, porcupine, snowshoe hare, beaver, wood-chuck, bobcat, raccoons, mink, otter, skunk, and muskrats. Crouse, pheasants, woodcock, and waterfowl are also found. Birds consist of hawk, upland plover, pileated woodpecker, snow owl, horned lark, raven; ten species of turtles, two species of lizards, and fifteen species of snakes are also to be found. Wildlife would move into the 548 acres of mitigation lands and the game lands now owned by the Commonwealth of Pennsylvania.

b. Permanent Changes. The multi-angularity and compactness of the proposed impoundment will create a new scenery and land use compatible with the region. The permanent changes created by the construction are in two categories. The first category includes those changes arising from the facilities proper, and the second category considers the changes caused by facility operations. The changes caused by construction

of the facilities themselves in the project area involve introduction of a dam, outlet works, spillway, and operation structures. Recreation facilities will be introduced in several selected areas. Other developments involve relocation of roads, utilities, and structures, some of which have been noted for their possible historical aspects. The changes caused by the operation of the facilities constructed in the project area are attributable to the creation of an 8-mile long lake and its operation for the purposes of producing water supply, flood control, and recreation benefits. These changes pertain to the stream environment upstream of the lake. Occurring upstream of the lake are possible changes in the resident fish habitat, and possible alteration of the water table. Changes in the lake area proper are the transformation of a free-flowing stream environment to that of a lake environment with a fluctuating pool level, with increases in shoreline length and water area, and alterations in water table elevations in the project area. A change in land utilization from primarily private agricultural and residential purposes to public use for recreation, water supply, and flood control will also occur. Approximately 360 acres of woods will be cleared. This change will be beneficial rather than detrimental. Introduction of a seasonal transient population into the area for recreation purposes implies solid and liquid waste disposal requirements, and hydrocarbon emissions from vehicles. Also there will be changes in policing requirements, local road and utility use, accompanied by increases in economic activity, and demand of local food outlets, and housing accommodations. In time, introduction of a permanent work force to maintain and operate the facilities constructed will give rise to similar demands.

Physical changes in the river downstream of the lake include more uniform low-flow patterns and an alteration of water quality as well as marine life regimen. The dam will reduce downstream flood hazard.

3.2 Effects of These Physical Changes. The changes outlined in the preceding paragraph will have effects of varying significance as discussed in the sequel.

- a. Construction. Initial environmental impacts arise from construction operations. Increased noise levels attendant to construction operations will not affect many persons other than the men actually engaged in construction owing to the remoteness of most of the construction sites ²⁷. The work force will vary, peaking at a population of about 200 persons. The resident population, within 30 miles of the construction site, is about 1 million. The percentage increase in population by introduction of work force entirely from outside a 30 mile distance from the construction would be insignificant in comparison to the population within

²⁷/ Currently, Congress is considering legislation which would limit the noise levels of construction equipment; any such limits set by law will apply to the Trexler Reservoir construction.

travelling distance of the construction. However, it is extremely unlikely that all of the work force will be non-local, as the immediate area of the project houses a large, industrialized work force which is predominantly steel and construction oriented.

The solid and liquid wastes generated by the work force will be treated and disposed of in accordance with applicable sanitary standards and hence will have no environmental impact. The obligation to perform that disposal will be a contractual requirement. In view of the insignificant increase in population brought about by the work force, the impact on the transportation system during construction in the area will also be insignificant. The increased utilization of housing and catering facilities will lead to greater economic activity in the area. The impact on the economic environment will be beneficial.

Dust is usually generated by construction activities; the amount of dust generated is governed by the dust control techniques employed. Dust control measures will be a contractual obligation of the construction contractor. What dust is generated by the contractor will not have a significant environmental impact.

Hydrocarbon emissions 28/ generated by construction equipment will have a somewhat adverse localized effect on the environment.

Almost all construction projects produce natural materials which must be wasted. The wasted materials are native to the region and will have no long-term toxic effect on the environment. There are numerous abandoned quarries in the area which can be used for disposal of cleared material. Also the possibility exists for an open-pit burning procedure in a manner which would be allowable under local, State, and Federal air pollution laws. The ultimate disposal procedure and sites for cleared wastes are determined by the contractor, and the contractors are responsible for complying with the existing State and local environmental legislation.

During construction clearing operations, materials will be temporarily located and placed about with very little net or permanent effect on the aesthetic environment. Rock and masonry rubble remaining from buildings during removal will be used to fill in old building foundations. Section 1 k of this document described the clearing process in detail.

Construction operations will require that some local roads be closed. Real estate acquisition and relocation of many residents will occur prior to the initiation of any construction so that the impact on the local transportation system will be negligible. Increases in the utility load (telephone, electric, gas, etc.) by the work force will be negligible as these

28/ The number of pieces of construction equipment required and the remoteness of the construction sites from manufacturing plants and heavy traffic indicate that the environmental impact of emissions will be minimal. Most of the construction will take place after emission control standards legislated by the Congress are effective; after that time, legal hydrocarbon emissions should have little environmental significance.

people will represent such a small percentage of the population in a twenty-five mile radius area. Increases in local and state police and fire protection activities to serve the work population will be required. Since the local resident population will have been relocated prior to start of construction, the local police and fire service will not have to be increased above the current levels.

During construction, the course of Jordan Creek will not be changed or diverted. The stream flow will be delivered downstream through a conduit tunnel, before embankment construction begins. After the conduit is in place, unimpeded fish passage will be possible.

Grass lands within the project area that are planned for recreational use will remain in sod. Other agricultural land, in the recreational area, will be seeded with a grass mixture compatible to the area and project use. The remaining agricultural lands under cultivation will be planted with various wildlife grass mixtures, grains and shrubs for the propagation and enhancement of wildlife. These lands will be under the jurisdiction of the Pennsylvania Game Commission.

Some of the areas which will be used for construction are currently utilized for wildlife habitat. In order to offset this loss, wildlife mitigation lands will be purchased and put into service prior to initiation of construction. Construction will require that large areas of ground be stripped of vegetative cover. The areas so stripped will, in those cases where they are not inundated as permanent lake area, be landscaped and vegetative cover re-established. Approximately one-half of the construction material (overburden and shale) for the downstream embankments will be obtained from the spillway cut, with the remaining material needed being excavated from borrow pits. Many of those borrow pits will be inundated by the permanent lake. In those cases where they are not inundated, the ground will be restored. In contrast to this, the right abutment of the dam will require excavation to a maximum depth of 65 feet for the spillway.

b. Project Facilities. Emplacement of the facilities alters the land utilization in the areas occupied. The majority of the 4,432 acre project will be occupied by a lake surrounded by undeveloped shoreline. The developed facilities will occupy less than 10% of the total project lands and hence their impact from a land utilization viewpoint is negligible. The dam, outlet works, spillway, and operational structures will change the aesthetic environment of the existing valley in the area. This change will be considered offensive by some persons but attractive by others. The location of the dam will be landscaped to blend the structure into the surroundings to maximize the aesthetic appeal of the project. As at other similar installations an overlook will be provided at this site to allow visitors to view the constructed works. Litter and solid wastes will be gathered and disposed of daily. Recreational areas will be controlled in accordance with day-use, thereby alleviating overuse, compaction of soil, or the destruction of vegetation. Following is a discussion of other effects of the constructed facilities.

(1) Spillway. A spillway cut at elevation 504 feet m.s.l. will be required for the operation of the flood control capabilities of the Trexler Project. The spillway will require a 200 foot wide excavation through a knob hill on the right bank of the project, approximately 500 feet upstream from the centerline of the dam. The maximum depth of the excavation at any point is 65 feet. The spillway cut will be perpendicular from the dam 800 feet in an easterly direction. The end of the spillway will then open up to a natural slope which trends approximately 600 feet downhill to the Jordan Creek. Flowage easements will be acquired for this section of natural terrain. The hill through which the spillway will be excavated is predominantly rock with medium-dark gray shale with thin interbeds of black slate. Since the spillway will not be lined with concrete, the exposed rock face can be expected to weather. The bedrock is susceptible to deterioration from freeze/thaw action, but will tend not to be susceptible to solution activity. There will be some constant erosion to the hill from natural runoff from rainfall; however, major erosion from use of the spillway for flood purposes is predicted to be a once in a hundred year occurrence. Day-to-day erosion caused by construction will be precluded by the construction contract specifications.

The location of the spillway cut is centered on the southern portion of the Trexler Game Preserve. This affected area of the Game Preserve is presently occupied by a zoo with penned animals and is the area which is planned to be developed into a larger zoo with an annual visitation of 350,000 people. The steepness of the portions of the cut (50 feet deep with a 4 on 1 slope) may provide a hazard to animals which are permitted to roam throughout the area. However, since the deep cut does stop 600 feet short of the stream bed, the animals can use this strip of natural terrain for a passageway. In addition, the animals can walk within the spillway in a direction parallel to the cut. Also as the rock face begins to weather, the footing will improve for animals who may attempt to traverse the excavation. Fencing along the tops of the spillway banks will be considered, in conjunction with barrier landscaping as a public safety measure. After development of the larger zoo is completed, the number of animals who will be roaming in the vicinity of the spillway should be minimal.

Probably the greatest environmental detriment caused by the spillway is to its aesthetic characteristics. The excavation will leave an exposed rock face scar in the earth where a knob hill with native vegetation once existed. The spillway will be easily visible from the higher terrain of the southern end of the game preserve. The elevations in the present zoo area of the Preserve are lower, however; and thus, all but the higher portions of the southern bank of the spillway cut will be hidden from the view of the majority of visitors to the Game Preserve. In the future, after development of the expanded zoo, a road and forest path will run almost adjacent to the spillway cut, therefore magnifying the aesthetic problem caused by the excavation. Also, due to the location of the cut and its related flow easements, any further expansion of the zoo beyond the planned 350,000 annual visitor capacity may be a physical impossibility.

The entire spillway cut will be visible from either of two proposed overlooks, which are being planned by non-Federal interests, and are to be located at the dam site area. To alleviate some of the sharp contrast between the spillway cut and the surrounding terrain, a restorative landscaping program is planned. Top soil will be placed on the spillway and will also be seeded to grasses to reduce erosion and the adverse aesthetic impact. Group tree plantings will be utilized to eliminate the sharp contrast between the spillway cut and surrounding terrain.

Four alternative site locations for the spillway were considered. The existing spillway cut is planned at approximately 500 feet upstream from the dam site. Other sites were considered at upstream distances of 1250, 2500, and 4500 feet. The three alternative spillway cuts range from 900 to 1200 feet in length in comparison to the proposed 800 foot long excavation. The other alternatives would also require a deeper excavation since the elevations at the other sites vary from 586 to 650 feet above m.s.l. versus the 550 foot above m.s.l. elevation proposed. The advantage of the alternative sites would be to remove the unappealing view of the earth cut from visitors at the dam site and Trexler Game Preserve by moving the spillway upstream into higher terrain regions.

(2) Relocations. There are no incorporated towns, cemeteries, or railroads in the project area which will require relocation. Approximately twenty-two miles of roads will be directly affected by the project. Of these roads, 3.3 miles of roads will be relocated, 5.0 miles of roads will be acquired for use in the recreation areas, and 13.9 miles of road will be abandoned and inundated by the lake.

Two major road relocations that will occur are on U. S. Route 309 (0.3 miles) and Pennsylvania Route 100 (0.6 miles). U. S. Route 309 will be relocated as a Class 2 highway for an average vehicle load of 3600 vehicles per day. Also a new bridge along U. S. Route 309 will require construction in the Mill Creek Area. Pennsylvania Route 100 is also a Class 2 road. In addition to the 0.6 miles of Route 100 to be relocated, other sections of the road will have to be raised above elevation 504 feet above m.s.l., the peak pool elevation of Trexler Lake. A bridge along Route 100 will also require relocation. When constructing the needed roadwork, all required cuts and fills will be minimized and where grades are altered, the crown and toe will be feathered smoothly into the natural contour.

Telephone and electric lines in the lake area will require relocation. Approximately 17.4 miles of electric lines will be abandoned and removed, while 22.8 miles of new lines will be constructed. Telephone lines totaling 26.4 miles will be abandoned and removed.

(3) Recreation Facilities. Construction of the recreation facilities will be in consonance with an attractive architectural theme. The resultant change in land use should be minor. A total of 918 acres will be acquired for the five planned recreation areas 29/. The areas will be developed to varying degrees with swimming, boating, picnicking, and sightseeing facilities. All areas will be provided with toilet facilities. Litter and solid waste will be gathered and disposed of daily. Since recreation areas are planned in accordance with park standards and use; minimum soil compaction should occur. There may be some vegetative destruction, but this should also be minimal.

The main architectural scheme of these areas is to blend the facilities in with the natural setting. Since about 75 per cent of the project area is unforested, the proposed recreation areas have been located to the greatest extent possible in forested areas. About 400 acres of recreation lands will require reforestation. Large trees (from four inch to six inch in caliper) will be salvaged from the reservoir area, and then planted adjacent to the recreation facilities to provide shade. These trees will be moved as required for the landscaping of the project area.

c. Project Operation Effects. Realization of project purposes as made possible by creation and operation of a lake involves changing the project area from a river type to a lake type environment. Comparison of the quality of the environment of the Jordan Creek with Trexler Lake to the quality of the creek without the lake represents the environmental impact of the project. The effects of lake creation include environmental changes upstream of the lake. A small but significant fishery improvement in resident fish in upstream areas can be expected. Ground water elevations will be altered in scattered locations of the upstream areas, and the fluctuating lake pool level produces alternate exposure and inundation of lands in some areas.

Introduction of a large recreation population and operating forces will have a pronounced effect on the area with respect to the liquid and solid wastes generated by those persons, required roads and utilities, and recreation facilities. The resultant land use change should be minor.

The main architectural scheme of these areas is to blend the facilities in with the natural setting. In conjunction with this plan, all power lines will be blended into the surroundings and will go underground in the recreation areas.

29/ Refer to Figure 3-1, p. 9-12.

The density of land utilization for recreation will increase. Regional aesthetics are compromised because what was a relatively isolated area will become more intensely used. With the lake, area fishing will be greatly improved over existing conditions; there will be no net quantitative change. The wildlife in the area will be enhanced. Present agriculture and housing will be deleted for land utilization.

However, the current county trend shows a decrease in agricultural employment and a trend towards a more commercialized and industrialized area. This trend may be exploited by commercial developers with, in many cases, scant regard for environmental protection. The planned recreation of the project is compatible with the environment. The elevation of the water table in the vicinity of the project will be raised; generally this is a favorable effect.

Other indirect effects can be attributed to project operations. Generally project purposes of flood control, water supply, and recreation will be served. Project development and visitation will accelerate economic, social and political changes in adjacent communities while the stream's flood plain as protected by the project will undergo a planned change in land use. Zoning of the flood plain downstream of the impoundment is the responsibility of local and county government. The Corps is participating in and otherwise encouraging this aspect of project flood protection. Accelerated population growth in surrounding communities will create a need for more public services (highways, schools, hospitals, utilities, etc.). Trexler Lake and attendant recreational facility development will attract intensive visitation from surrounding urban and suburban areas while partially satisfying a portion of open space needs of the State area. Present over-use of recreational facilities at area State parks will also be decreased. Scenic, historic, scientific, and cultural artifacts, extant in areas which would otherwise have been lost to private development or enjoyed only for a few private interests, will be preserved and made available to the public. Eight miles of existing stream, the majority of which previously was available only for private use, also will be available to the public for recreational activity. Extensive visitation attracted to the project area and adjacent communities will increase solid and liquid waste loads existing in the area. Minor increases in noise and air pollution will also result from project development.

Creation of the lake and development of recreation areas will affect wildlife environment and create a need for acquisition of supplemental wildlife lands. Lands within the project area, which otherwise could have been lost to encroaching private development, will be acquired and preserved for wildlife habitat lands. In addition, the lake will affect standing fish crop, fish spawning grounds, and the environment (plant growth and food chain) for resident fish, none of which are anadromous.

(Species listed in Section 2 under fishery). The nutrient concentration profile within stream reaches affected by project development will be altered; therefore, the lake and altered stream regimen will affect vegetative cover adjacent to the new lake shoreline. Plant growth may be enhanced within the reservoir area and returned downstream due to change in stream flow nutrient concentration. The lake surface will offer resting areas to migratory birds on the North American (or Pan Am) Flyway.

3.3 Analysis of the Environmental Impacts Stemming from Physical Changes Caused by the Project.

The preceding paragraphs of this section have identified the physical changes and associated effects occasioned by the project which have significant impact upon the environment. As these impacts can best be analyzed in terms of their direct and indirect effects, they are treated below on that basis.

a. Construction Activities. Construction operations attendant to the project will disrupt the landscape, necessitate clearing of some forested areas and produce intermittent muddy haul roads and stream turbidity. These effects are of short-term character, lasting less than three years. The principal effects will be confined to the immediate area near the dam site and the road relocation projects in the upstream areas. An overriding consideration is that actual building operations and procedures are within the scope of the construction contract specifications and thus subject to close control by the developing agency.

Trexler Lake Project planning has anticipated the diverse potential sources of environmental degradation and applicable contractual specifications regarding flora and fauna, stream siltation and other environmental construction hazards will be enforced to control pollution to the maximum extent practicable. Contractor performance will involve full compliance with detailed environmental protection specifications. In particular, prior to commencement of the work, the contractor will submit in writing for approval his detailed proposals for implementing environmental pollution control.

During construction, the contractors will be required to avoid contamination of the streams traversed and to prevent erosion. The majority of borrow material for construction at the dam site will be taken from the spillway and lands within the area of lake inundation. Restorative landscaping will be provided to blend new construction into the surrounding landscape. The adverse aesthetic effect caused by the dam, appurtenant structures, and excavation will be minimized by architectural treatment

of exposed structural features and implementation of an appropriate landscape architectural plan for treatment of construction scars. The planned remedial landscaping should also aid in the prevention of erosion and the control of dust. Diversion terraces and retention dams will be constructed to reduce erosion and sedimentation. All disturbed areas will also be reseeded with grass mixtures which should reduce runoff and erosion of the soils.

b. Dam Embankment. The presence of the dam embankment will alter the loading on the underlying soils. This artificial land form represents a small superimposed load safety accommodated by the design location of the dam axis.

c. Creation of a Lake. Impoundment of waters behind the Trexler Dam will cause the replacement of a gently flowing stream of average one foot depth and 25 foot width with an 8 mile long lake of average 1000 foot width and a depth which varies from 114 feet maximum depth at the dam to 5 feet at the upstream limit of the lake. The lake waters will permanently inundate 1220 acres of land in addition to the 80 acres now covered by the existing stream and, infrequently, would affect an additional 260 acres of land during temporary storage of flood waters.

(1) Eutrophication. One of the environmental problems associated with the newly created impoundment will be control of eutrophication. In its natural state, the Jordan is an enriched, flowing creek. When the flow is obstructed by the dam at time of closure the entire ecosystem will be disrupted. After the initial change on the system, a modified ecosystem will develop. The new system within the lake will be characterized by warmer water, reduced flow velocities, and additional shallow water along the lake periphery. In the new lake there will be tendency for the soluble nutrients to be utilized by higher aquatic plants or by algae. These in turn may die, sink to the bottom and contribute to the organic build-up and consequent BOD.

The nutrient utilization can follow two paths. Some of the nutrient will stimulate both floating plants and submerged plants. Alternatively the nutrients may be used in the production of algae. Rapid growth of algae produces an algae bloom characteristic of eutrophication conditions and appears on the water surface. Dead and dying algae blooms can be extremely odiferous, and after sinking to the bottom, deplete the dissolved oxygen in the lake waters.

Both plants and algae may occur simultaneously in different reaches of the lake. The lowered oxygen content associated with high organic matter under such conditions further defines the environmental conditions for fish and for water-based recreation purposes. The operation and maintenance features of the water management programs for the lake will consider this natural phenomenon. In particular, regulation of detention

time will greatly reduce the reaction time in which the nutrients can express themselves in the form of eutrophication.

Excessive amounts of soluble nutrients (nitrates and phosphates) are believed to be a main factor in the eutrophication process. Of course, natural conditions such as temperature and sunlight are also essential. The possible source of the nutrients in Trexler Lake will be from both natural and created processes. The natural decay of vegetation and animal wastes are the principal natural sources of phosphates and nitrates. Water samples taken in 1968 in coordination with the Pennsylvania Department of Environmental Resources showed high fecal and streptococcal coliform counts. This condition was probably due to improperly treated domestic sewage, livestock manure, and agricultural fertilizer runoff. Major point sources of nutrients have been identified and abated by the Pennsylvania Department of Environmental Resources. Principal sewage outfalls and their volumes along with other pertinent data pertaining to Jordan Creek are outlined in Table 3-1.

Eutrophication is a natural phenomenon in the life cycle of a lake. However, when excessive plant and algae growth occur very rapidly and cultural eutrophication is pronounced, lake benefits decline in value. To prevent cultural eutrophication, possible sources of decay and nutrient buildup must be eliminated. During the clearing process, all land that will be inundated by the lake will be cleared of all vegetation, floatable structures and cesspool and septic tank contents. By performing this clearing, the initial intense threat of eutrophication of the newly formed lake will be minimized. The initial eutrophication condition of a newly formed lake usually stabilizes within five years of formation as long as new sources of nutrients are controlled. To inhibit cultural eutrophication, it is recognized that careful control of outfalls in the tributary waters must be performed. The problem of nutrient source control in the upstream feeder streams of the lake must be coordinated on the private, local, State and Federal levels.

Various corrective actions may prove effective at Trexler and will be considered further if eutrophication becomes pronounced. These measures are:

- (1) Mechanical elimination and removal of excess plant growth.
- (2) Aeration of lake water through pressurized air lines along the lake bottom.
- (3) Use of holding ponds in the shallow upstream reaches of the lake.
- (4) Chemical control.

TABLE 3-1

SEWAGE OUTFALLS AND THEIR VOLUMES

Source: Department of Environmental Resources, West Reading, Pa.

Name of Plant	Type of Plant	Design Maximum	Average Flow	Type of Treatment	Stream to Which Discharged
1. Heidelberg Hts. Housing Developments	Extensive aeration with micro-strainer	59,000 gals/day	29,000 gals/day	Tertiary	Tributary of Mill Creek (above dam)
2. Lehigh County Community College	Extensive aeration with sand filters	63,500 gals/day	36,000 gals/day	Tertiary	Tributary of Jordan Creek (below dam)
3. Parkland Union School District High School	Extensive aeration plant	32,000 gals/day	20,000 gals/day	Secondary	To Jordan Creek (below dam)
4. Northwest Lehigh School District - Weisenberg Element- ary School	Extensive aeration with sand filters	33,800 gals/day	30,400 gals/day	Tertiary	Lyon Creek
FUTURE PLANTS PROPOSED					
1. Trexler Game Preserve					Downstream of Dam
2. Mill Creek Acres					Above Impoundment on Mill Creek

Trojan Powder — Industrial Waste — 11 Lagoons with two aerated
Also — Lagoons with chemical treatment
John's Potatoes — two lagoons — no discharge

Although the concept of mechanical elimination and removal of excess aquatic vegetation is the most desirable from an ecological viewpoint, it is costly, highly inefficient and can be used only for larger vegetation with any degree of success and does not address the problem of reducing levels of indigenous primary plant production. Aeration of the lake bottom through pressurized air lines is a very promising technique for preventing nutrient accumulation and reducing BOD; however, it is still experimental and has not been tested in an impoundment as large as Trexler. As for holding ponds, their value for Trexler cannot be assessed since the degree of eutrophication which may occur cannot be determined until the lake is in actual operation.

Chemical control employing biodegradable low toxicity for aquatic plants has been used with considerable success by the Corps in the past and with minimal environmental disruption. Use of copper sulfate in small quantity has proved effective for algae in the past and has been demonstrated to be non-toxic (in concentrations used) for fish. Studies have demonstrated that fish are not killed by copper sulfate at minimum concentrations for algae control and that fishing yields have not deteriorated in lakes so treated over long periods of time.

(2) Wildlife with the Project. Clearly some wildlife habitat will be eliminated. However, the lake will be adjacent to the Trexler Game Preserve, State Game Lands and the wildlife mitigation lands, acquired as part of the project. These areas should provide ample refuge for animals displaced by the lake. The lake will claim 150 acres of existing State gamelands and approximately 200 acres of the Trexler Game Preserve. These losses should be mitigated, however, as the Trexler Game Preserve plans a 330 acre expansion of existing facilities and the 234 acres of wildlife mitigation land will be adjacent to the State Game Lands and be homogeneous when the hunting area is considered. No rare or endangered species will be threatened by the project development.

The Lake surface should provide for increased waterfowl use. The increased waterfowl use should be guaranteed by more resting grounds, less poaching and other human disturbances as a result of more conservation oriented management.

(3) Fishery. Presently the Jordan Creek supports a diversified fish population. In the upper reaches of the creek, the alkaline nature of the stream supports a high quality warm water fishery. The following is an inventory of the current resident fish population: small and large mouth bass, blue gill, pickerel, sunfish, black-nose dace, darters, white suckers, shiners, pumpkinseed, American eel, and numerous other species. Other than the bass and sunfish potential, there is very little game fishing potential in the upstream reaches of Jordan Creek.

Following improvement, the lake should provide excellent fishing potential. Certain species now present in the creek such as some shiner species, dace and some species of pickerel probably will not adapt to the new lake environment. However, species such as bass, alewife, bluegill, pumpkinseed, pike, black crappies, muskellunge, and carp should adapt readily to the warm surface waters of the lake environment.

The Pennsylvania Fish Commission will stock the lake with muskellunge (*Esox masquinongy*), chain pickerel (*Esox niger*), largemouth bass (*Micropterus salmoides*), Walleye (*Stizostedion vitreum*), and black crappie (*Pomoxis nigromaculatus*). None of these fish are anadromous. This should provide the potential for excellent game fishing. A pre-impoundment environmental inventory for Jordan Creek is given in Table 3-2. The most favorable new habitat for fishes by any major land or water use has been man-made reservoirs. These reservoirs commonly support standing crops of over 200 pounds of fish per acre, and provided a sport catch of over 121,000,000 pounds in 1960.

Because of Trexler Lake, the resident fish population will expand rapidly for a period of 6 to 10 years following impoundment. Following this period, the fishery will change from an outstanding fishery, with the major part of the catch being game fish, to a good fishery with game, pan and rough fish all represented in the catch. Seining areas established along the lake shoreline and a lake drawdown program during rough fish spawning periods should effectively control rough fish populations, which would otherwise overpopulate the lake. Consideration will be given to the introduction of northern pike, striped bass, coho salmon, and other predatory species to provide additional sport fishing and to control utilization of alewife, carp and other forage fishes which are likely to become abundant. Provision of boat ramps and parking facilities, fishing piers and fish concentration structures in the lake will increase fisherman use of the resident sport fishery. The resident sport fishery above the lake will not be affected by project development.

Below the dam there may be some detrimental effects to the fish life. The planned low flow release of 5 cfs from the dam will be less than the average stream flow currently. However, the major fishing potential now present in the Jordan Creek is in a stocked area near Jordan Park. This tract area of the creek is fed by cold springs, and should not be greatly affected by the low flow releases caused by the project. Also, if the cold bottom waters in the reservoir can be maintained, the lake could possibly provide suitable habitat for trout.

The spawning of most desirable fish species is not expected to be interrupted by drawdown. With some species, eg., carp and sunfish, the drawdowns can be used to benefit the fishery by destroying unwanted spawn. However, the changes in water level could possibly interfere with pike and pickerel spawning through elimination of aquatic plants necessary to

TABLE 3-2

PRE-IMPOUNDMENT ENVIRONMENTAL INVENTORY: JORDAN CREEK FISHERY

<u>Adaptability</u>	<u>Common Name</u>	<u>Scientific Name</u>
Yes	American Eel	<u>Anguilla rostrata</u>
Yes	Bluegill	<u>Lepomis macrochirus</u>
Yes	Bluntnose Minnow	<u>Pimephales notatus</u>
Yes	Carp	<u>Cyprinus carpio</u>
Yes	Common Shiner	<u>Notropis cornutus</u>
Yes	Largemouth Bass	<u>Micropterus salmoides</u>
Yes	Pumpkinseed	<u>Lepomis gibbosus</u>
Yes	Redbreast Sunfish	<u>Lepomis auritus</u>
Yes	Redfin Pickerel	<u>Esox americanus americanus</u>
Yes	Smallmouth Bass	<u>Micropterus dolomieu</u>
Yes	Spotfin Shiner	<u>Notropis spilopterus</u>
Yes	Spottail Shiner	<u>Notropis hudsonius</u>
Possibly	Rock Bass	<u>Ambloplites rupestris</u>
No	Blacknose Dace	<u>Rhinichthys atratulus</u>
No	Brown Trout	<u>Salmo trutta</u>
No	Creek Chub	<u>Semotilus atromaculatus</u>
No	Fallfish	<u>Semotilus corporalis</u>
No	Johnny Darter	<u>Etheostoma nigrum</u>
No	Margined Madtom	<u>Noturus insignis</u>
No	Shield Darter	<u>Percina peltata</u>
No	White Sucker	<u>Catostomus commersoni</u>

their reproduction. The drawdown could also possibly strand and kill some young fish that frequent the shallows. A critical drawdown will not take place during the game fish spawning season. The impacts of drawdowns as well as of daily fluctuations on fish and wildlife uses will, of course, be greatest in late summer and fall. The rate of fishing use probably will be reduced somewhat more in later summer and fall during years of moderate to extreme drawdown than in normal years, but fishing success probably will be greater. The reduced rate of use is expected as a result of lessened attractiveness and length of the shoreline, lessened utility of access facilities, smaller surface area, and greater competition among users. Similar effects on recreational users other than fishermen seem probable, and scenic values during the fall season will undoubtedly be greater during years when the lake is full.

To assure full fishing use of the lake, special fishermen access facilities and lake area zoning against conflicting boat uses have been recommended and are included in current plans. In addition, fishery management studies should be conducted during the early years of lake operation to guide proper management by the State in cooperation with the Corps of Engineers.

(4) Geology and Soils

The inundation of the valley will not appreciably affect the economic geology of the area. The area is generally sandy shale. Exploitable resources will be reduced only slightly since similar deposits exist in contiguous areas. Aquifers in the surrounding valley areas will be enhanced by the lake level and will provide easier access to plentiful water supplies by the drilling of wells. The resource potential of the area appears to be minimal. There is no indication of any potential in the project area for coal, natural gas, or oil deposits. The project area does not provide the potential for a commercial quarry. There is an existing fossil area on the banks of the streambed of Jordan Creek in the vicinity of Route 100. The major portion of this geological area will not be hindered by the Trexler Reservoir. The fossil area is at the extreme northern end of the reservoir and would be affected only when the flood control pool is used, or approximately once every ten years. Even during this rare occurrence, only a small portion of the geological area would be affected.

(5) Archaeologic and Historic Features

Unique features such as areas of historical, archaeological, and ecological interest above the normal pool elevation will be preserved in their natural setting. Examples are the covered bridges downstream from the dam and the Indian bake oven located in the Trexler Game Preserve. Rex's and Geiger's covered bridges, both built in 1858, will not be affected by the project. The covered bridge directly downstream from

the dam site will also be preserved. The Indian bate oven is located above the flood plain of Jordan Creek downstream from the dam. The State plans to make this unique structure, which is chiseled out of solid rock, a shrine to the Lenni Lenape Indians.

In the area to be inundated by Trexler Lake, two surveys have indicated conflicting views on the significance of the area. In 1963-1964, Temple University, under contract with the National Park Service, made an archaeological survey of the Trexler Project area. Local resistance and lack of cooperation was a deterrent to the field work accomplished by the archaeologists. This and subsequent investigations, however, revealed nothing of historic significance in the area to be salvaged. In contrast to the before-mentioned surveys, the Pennsylvania Historical and Museum Commission surveyed the area in 1971 and discovered certain structures that were interesting from an architectural standpoint ^{30/}. The structures sited were two houses and a small cast iron bridge which dates back to 1876.

The funding responsibility for relocation of historical structures lies with either State or Federal Commissions involved with historical preservation. The Corps and its real estate activities will cooperate fully towards relocating any historical structure, provided that funding comes from the State or authorized Federal source. With regard to the two specific houses mentioned as having architectural merit, the State of Pennsylvania will be permitted to bid on the salvage of these structures, provided that the original owners do not wish to exercise their right of salvage retention. The iron bridge specified in the Pennsylvania Historical survey is being considered for possible use in the recreation area of the park, but has not yet been included in any of the preliminary recreation plans. Before any decision can be made on the use of this iron bridge, justification of the structure's historical significance must be provided. The National Register of Historic Places (1969) has been consulted. No entries therein are affected by the Trexler Lake Project.

(6) Lake Water Fluctuation. The interaction of natural lake inflows and the lake management program will produce both long-term and short-term water level fluctuations. Analysis of these long-term variations considered scattered mud banks and flats with attendant rooting problems, impeded access to lake waters, and design constraints on water-related recreational facilities. The impact of these features is direct and moderate. Bank and flat areas to be intermittently exposed have been identified for sanding to promote rapid draining of in situ soils. This particular design measure has been utilized at other recreational lakes. It should be emphasized that drawdowns at other reservoirs (refer to Table 1-2) far exceed the fluctuation to be found within Trexler Lake. Experience also vindicates the judgement that fluctuating waters will not

^{30/} June 1971, Letter from Pennsylvania Register of Historic Sites and Landmarks.

materially impede access to the lake or detract from water-based recreation. Supporting facilities in the land/water zone include design provisions (size, layout, and adaptability) to accommodate water level fluctuations.

In the course of an average year's operating cycle, the average drawdown will total 7-1/2 feet. The most influential time period for the effect of drawdown is the summer season when aesthetic and ecological considerations are of prime importance. During the June through September period, the drawdown should average 5-1/2 feet. This drop in the pool level will expose 155 additional acres of bottomland. Although this exposed acreage is generally spread over the 35 miles of the lake shoreline, it is most prevalent in the shallow areas of the upstream reaches of the lake. There is a ten percent probability of a drawdown of 23 feet to the 470 level. This once in ten-year occurrence would expose 425 acres of previously inundated bottomland. This is a considerable amount when compared to the normal 1220 acre surface area of the lake. This severe drawdown will expose bottomland chiefly in the tributary areas of the lake, in some cases, as much as 4500 feet long. Also, generally throughout the reservoir, the width of the lake will be reduced by approximately 1/3 its normal size.

Although the bathing and boating beaches will be sanded to elevation 464 feet above m.s.l., or 6 feet below the once in ten year drawdown, the recreation potential of the reservoir will be severely hindered by a severe drawdown. It must be mentioned, however, that drawdowns more severe than those expected at Trexler Reservoir occur annually, and do not seem to hinder recreation attendance.

Normal drawdown during the recreation season will be minimal, approximately 3/4 inch per day. Land exposed as a result of lowering of the lake level is generally steep sloped so that drainage will not be a serious problem. In the flatter areas in the upstream reaches of the reservoir, the soil is free-draining. However, some areas will require drainage to prevent secondary ponding which could become breeding places for mosquitos and other nuisance vectors.

A positive program for mosquito control is anticipated, employing U. S. Public Health Service criteria. Typically, small rivulets can be incorporated into the bank area as required to preclude ponding in such locations. Field studies after impoundment will be conducted to determine which areas will require drainage and other measures to prevent and control mosquito and black fly populations. As an added precaution, during clearing operations, objectionable features such as cesspools, land fill sites, and swamps will be treated in accordance with applicable H.E.W. and Pennsylvania Department of Health Standards to avoid the breeding areas for disease and nuisance vectors.

A continually updated lake operations program will coordinate the demands on the lake during the life of the project so that commitments to water supply, recreation, and fish and wildlife can be met. Controlled changes in lake water level can effectively control some environmental problems. However, the ultimate effect on certain elements of the environment, such as the ability of specific aquatic plants to root, cannot be fully understood until some operational experience with the lake has been obtained. Because there are a variety of soil conditions and ground slopes involved and many aquatic plants available, no single solution to the control of aquatic plants is expected to be effective.

d. Establishment of Recreation Area's Usage. The summer conservation pool will offer a 40 mile shoreline and will be supplemented by a plan of water-related recreation development which will initially support an estimated 185,000 visitors annually. The recreation facilities can be ultimately expanded to accommodate as many as 424,500 visitors, and public access will be permitted along the entire shoreline except at the dam site.

It is the Corps policy to maximize the aesthetic value of the natural setting in the development of all recreation sites. The maintenance of all landscape and groundwork will be the responsibility of the State after the initial construction by the Corps. The daily traffic load should be sufficiently handled by the extensive superhighway network which services the area. The usage of arterial roads (U. S. Route 309 and Pa. Route 100), which directly service the project area, is presently from 2,000 to 10,000 vehicles per day below design capacity. Therefore, the increased usage of Trexler Lake should not present any major transportation problem.

A well planned waste control management program is necessary in order to accommodate the recreational usage anticipated at key locations throughout the project. Funds to the amount of \$500,000 will be provided to supply drinking water and adequate, sanitary sewage disposal for visitors to Trexler Lake. There are five comfort stations (water-borne sanitary facilities) and five vault latrines planned. Wastes from the water-borne toilets (generally located in picnic and boat launching areas) will be piped to a sewage treatment plant which will be built in conjunction with the project. Recreation areas which are serviced by vault-type latrines will have the waste trucked to the treatment plant. The latrines will be constructed so that they can be converted into water-borne facilities at some future date. Also the vault will be concrete lined to prevent any seepage of sewage waste into the groundwater; thus avoiding a possible pollution source. Preliminary plans for the treatment plant anticipate that innovative systems such as land disposal using lagoon-like treatment cells and spray irrigation technology may be effectively employed. This system will be considered in conjunction with a sewage plant with the effluent being discharged below the reservoir. In either situation, the sewage plant effluent will meet all State, Federal, and DRBC water quality standards.

4. Adverse Environmental Effects Which Cannot Be Avoided. Implementation of the project in a rural valley will modify the aesthetic and intrinsic characteristics of the natural scene, remove productive farmland which contributes to the area economy, relocate the community organization and social structure, remove tax ratable lands from the county rolls and eliminate natural wildlife habitat. The reservoir would convert 8.6 miles of free-flowing stream to a slack water impoundment. In the project area, the scenic qualities of the open space which has been preserved by the Trexler Game Preserve, State game lands and the rural agricultural valley upstream from the dam will be lost. Those scenic qualities will be replaced by the scenic characteristics of a valley lake. Productive farmland, portions of the Game Preserve and State game lands, and tax-ratable land will be lost. The project will have a severe effect upon Lowhill township since over 50 per cent of the township will be acquired for the project. Fish and wildlife habitat loss is mitigated by both additional acquisition of land and by the introduction of a wildlife management program to the area. Public use of project lands will act to diminish water contamination from agricultural chemicals and human and animal fecal material introduced into the lake by natural overland drainage. The regional trend toward development and associated environmental degradation will be reversed with implementation of the project due to provision for fishing, hunting, and general recreation, and attendant orderly use of the surrounding lands. The project, however, will result in other environmental impacts which may be adverse. Of the various environmental impacts discussed in Section 3, only the following involve adverse effects which cannot be mitigated or avoided with the project as now formulated.

(1) During construction. Construction operations will necessitate extensive removal of surface and rock material along the site of the spillway, thus exposing a large rock outcrop. Construction contracts will incorporate rigid controls on the construction methods in order to minimize and confine the destruction of existing vegetation, unnecessary grading of the landscape and temporary silt load pollution of stream. Corps of Engineers provisions for environmental protection 31/ will be applied by the Contractor as monitored by the Resident Engineer.

As the water level rises, wildlife will migrate to higher elevations. In case of warm water fish species, they will remain to become part of the lake. Stream levels will be stabilized for the fishery during construction.

(2) Post-Construction. Excavation for the recommended location of the spillway, outlet works will expose the base rock of the region. The inherent attraction of the rock arising from its color and veination may be diminished somewhat because of its extent and in some locations abrupt transition with the surroundings.

31/ U. S. Army Corps of Engineers Regulations EC 1110-2-109.

One major environmental change results from implementation of the project. The spillway, to be constructed over the ridge of the peninsula containing both the zoo portion of the Trexler Game Preserve and the project operations buildings, will create a large cut readily observable from Game Preserve and project overlooks. The spillway location limits Game Preserve expansion options and confines multiple Federal and non-Federal public uses on the peninsula to the narrow tip. Because of its size, the spillway cannot be effectively screened to totally eliminate the unpleasant aesthetic aspects.

Land use change accompanied by construction scars will result. Visitor use is provided to a degree less than that which might cause damage to the project lands. Construction scars will be ameliorated by grading, seeding, reforestation; landscaping will be provided as required. Effluents from the sewage treatment plant will be properly treated under State regulatory standards. Original unsanitary site conditions will be eliminated by removal of the sources within the project area. It is anticipated that operation and maintenance of the recreation facilities will be the responsibility of the Pennsylvania Bureau of State Parks.

(3) Mitigation Design. Several earthwork design aspects have been advanced to improve the treatment of the rock outcrop area. Briefly these ideas include: direct soil application, development of surface vegetation, and architectural sculpturing of the rock. In this connection, an added study of the total project environment in the vicinity of the dam and the excavated area will be made. Such studies will identify treatments or techniques, presently in the development stages, which can be successfully employed to aesthetically enhance the present design.

a. Land Acquisition and Relocation. Construction of the project will require acquisition of about 3280 acres of lands for development and subsequent operation and maintenance, 918 acres for recreational facilities, and 234 acres of wildlife mitigation lands. However, not all of these lands will be altered from their present use. Development of the project will also require displacement of 348 residents from the project area. Displacement relief for those residents will be provided under authorities of the Relocation and Assistance Act of 1970 (PL 91-646).

b. Impoundment. The major adverse effect of the lake will be the permanent loss of an 8.6 mile stretch of the free-flowing Jordan Creek and inundation of 1220 acres of adjacent lands, in addition to the 80 acres now covered by existing streams. These streams have largely retained their natural appearance and scenic charm because of limited public use. Creation of Trexler Lake would preclude preservation of Jordan Creek and existing streams in its present natural state. On the other hand, creation of Trexler Lake would provide increased public access and use of semi-natural conditions through appropriate acquisition of streamside lands.

The branch of the lake that will go up the existing Jordan Creek streambed to Pa. 100 will inundate a small part of a geological site containing low-grade marine fossils, while the branch that will go up the Mill Creek streambed will partially flood small portions of an area which includes a stand of arrow-wood.

Impoundment of the river to form a lake will accelerate natural eutrophication of the stored waters to an extent which is not now fully known. While the total dissolved solids content of the Jordan Creek is low compared to water stored in most large impoundments, significant quantities of phosphates and nitrates exist because of agricultural runoff and treated sewage effluents upstream of the lake.

There is, at present, only meager basic understanding of eutrophication and interrelated limnological processes in lakes, and predictions are somewhat uncertain. Future growth in upstream population and visitation to the proposed recreation developments along the lake would, of course, increase the rate of eutrophication unless corrective actions are undertaken.

One possible adverse effect of eutrophication, should it occur to a significant extent, is development of excessive blooms of algae in Trexler lake. These blooms could impair the attractiveness of recreational use of the lake and the lakeside developments and diminish the value of stored waters for municipal and industrial uses. Another possible effect is development of a low dissolved oxygen content, during the summer, in the bottom layer of the lake. This reduction of dissolved oxygen would be caused by decay of algae and other detritus that sink to the bottom. The effects of eutrophication would also deleteriously affect the fishery in proportion to the severity of the condition. To combat eutrophication, a multi-level withdrawal system is planned. This system would cause a mixing of the various layers of water, thereby reducing the effects of eutrophication. As part of the management program, an oxygen delivery system may be installed on the bottom of the lake.

Working experience with other reservoirs suggests that, even where impoundment conditions appear to be highly favorable for utilization of nutrients such as calcium, potassium, nitrogen, and phosphorus by algae, with consequent blooms, the reservoirs do act as a nutrient trap; but with proper management, this condition can be effectively managed. A large proportion of the nutrients are passed through the reservoir without being incorporated into the biomass of the reservoir. Much of the phosphorus on the other hand does appear to be precipitated and adsorbed by the bottom muds, but in an insoluble form.

Although variable from reservoir to reservoir, the amount of organic material produced within the impoundment is considerable and either accelerates eutrophication or enters the food chain in significant quantities. The primary factors which may be responsible for induction of eutrophic processes in the lake environment will not necessarily be from upstream enrichment, but rather from primary production.

Although nutrient loading may prove to be a major factor in eutrophication of Trexler Lake, the major operative factor will be massive habitat change, (from relatively rapid stream to stillwater impoundment) which allows for establishment of a large biomass of primary producers of organic material. Due to the present state-of-the-art there is no way to predict the degree of eutrophication at Trexler other than to say, like all lakes, it may be a problem on an intermittent basis.

Heavy reliance on use of copper sulfate and on other algicides to control algal blooms may not be made in accord with existing State practice with a view towards minimizing temporary deleterious ecological effects. Such measures, if employed, would only supplement the preventive management. Multi-level openings in the outlet structure offer the opportunity to control oxygen quantities and impoundment level mixtures for sound water management.

c. Recreation facilities. Initial lakeshore recreation facilities, with a daily design peak capacity of 2,475 visitors, will be installed concurrently with project construction. Ultimate peak visit or design load for water-related facilities is estimated to be 424,500 people annually.

Available 1970 census data indicate continuation of the population trends foreseen in that report. The population of each of the two counties adjacent to the project area has increased significantly over the past two decades.

Regional growth trends have been encouraged by improved access to the adjacent Pocono and northern New Jersey areas and by an increase in the number of families seeking natural outdoor recreation opportunities. The anticipated general impact of the Corps recreation developments on the surrounding area would be an acceleration and intensification of these trends. The most likely result appears to be a mixture of adverse and favorable environmental and socio-economic effects.

The lakeside recreation facilities, in the pleasant scenic setting, are expected to be the major source of visitor attraction to the reservoir. Despite the best efforts to spread visitor pressure effectively among the facility areas and to minimize visitor impact on the area, there will be unavoidable occasions during which traffic congestion and visitor overuse will occur with resultant adverse effects of short-term damage to the surroundings. Unsightly accumulations of trash and litter are nearly inevitable under such circumstances, and will mar the visitor experience somewhat for short periods of time. However, enforcement of local and Federal anti-littering laws and regulations will ameliorate this situation. During summer weekends and holidays, in particular, traffic congestion induced by the presence of the recreation facilities will adversely affect, to some degree, adjacent highways and communities.

Many of the region's residents, particularly those in the low income categories, will welcome better socio-economic conditions as an improvement. The provision of short-term services for visitors, such as daily and weekly sleeping accommodations and eating establishments, will stimulate the local economy and create jobs for many residents.

Many permanent and seasonal residents will be distressed over the loss of the existing predominantly rural and scattered commercial development pattern. Careful zoning controls and other local regulatory measures will be needed to prevent future commercial development of service to the visiting public from occurring in areas outside the lake project, in a way that conflicts with sound regional land use plans.

d. Operation of the lake. As discussed in Section 2 of this statement, Trexler lake will be operated to pass a minimum daily flow of 5 cfs throughout the year. The average yearly drawdown will be 7-1/2 feet, although drawdown during the 14 week prime recreation season will average 5-1/2 feet. Larger drawdowns will, of course, occur in drought years.

A five foot reservoir fluctuation from the recreation pool elevation of 493 will occur frequently, thereby exposing areas of barren shoreline throughout the impoundment area. Controlled releases of water will be provided to maintain a stream flow comparable to existing conditions downstream where past history indicates that Jordan Creek has often dried up during low flow periods due to the loss of water to the underground aquifer. The project will also reduce the full effect of natural flushing and cleansing occasioned by seasonal high flows.

The adverse effects of drawdown and fluctuation are primarily aesthetic. The Bureau of Sport Fisheries and Wildlife, in its appraisal of the Trexler Lake Project, concludes that adverse effects on fisheries will be minimal, and even possibly helpful, in its disruption of spawning of less desirable rough fish. Additional studies pertaining to artificial spawning areas for game fish are in progress.

The aesthetic effect is not likely to be substantial, since 80% of the shoreline is steep-sloped with most of the soils along the rest of the lake shore being free draining. Therefore, the exposure of these lands is not expected to produce any substantial area of saturated soils. Minor drainage or other measures will be undertaken to minimize mudflat problems where they may exist. Adverse effects on recreational use are not expected since beach areas and supporting facilities will be designed to accommodate the drawdowns in all but the most extreme drought years.

5. Alternatives to the Proposed Action. Presented below are various alternative actions that might avoid some or all of the adverse environmental effects. These alternatives were explored in the course of development of the Trexler Lake project. Evolution of the project, as well as its formulation within the framework of the Delaware River Basin Plan, is discussed in detail within the report on the Comprehensive Survey of the Water Resources of the Delaware River Basin. 32/

a. Background. The inventory of potential major reservoirs included sites proposed in thirty-five prior reports covering water resource development in the basin or identified in additional studies made in connection with the Basin Plan. A total of 193 major dam and reservoir sites were compiled. Of necessity, the subsequent selection process was extensive due to the permutations and combinations implicit in the number of sites proposed. A further complication was the interdependency of the basin physical characteristics. That is, the introduction of a project on a single tributary of the region will generally affect, to some extent, the regional water resource characteristics. The evaluation method used in the survey for deriving the composition of the recommended Basin Plan involved a set of successive discrete screenings of proposed projects followed by detailed appraisals of the resulting preferred plans. In this manner, the present plan was defined.

In examining the alternatives to the proposed action, it is helpful to frame the discussion in terms of the adverse effects of the multi-purpose project as identified in Section 4 of this statement. Also refer to the conspectus for this section. These characteristics may themselves be placed in three physically-motivated classes as follows:

A. Adverse Characteristics Brought on by Creation of Lake

1. Loss of free-flowing stream qualities
2. Reduction in agricultural production
3. Exposure of extensive rock cut at the spillway
4. Accelerate natural eutrophication
5. Hardship related to relocation and acquisition
6. Loss of some wildlife habitat
7. Decrease in tax ratables (temporary)
8. Inundation of sites of botanical interest

B. Adverse Characteristics Arising from Lake Operations

1. Drawdown and aquatic-plant rooting problems
2. Resident fishery changes

32/ December 1960 (revised May 1961) in eleven volumes. Printed and distributed by the U. S. Government Printing Office, 1962, as H. D. 522. See especially Appendix O: Formation of the Plan of Development.

TREXLER LAKE PROJECT CONSENTS

EXPLORATION & EVALUATION OF ALTERNATE ACTIONS THAT MIGHT AVOID SOME OR ALL ADVERSE ENVIRONMENTAL EFFECTS

Acquisition
Hardships

Lake Operation

Drawdown, Plant
Rooting & Fish
Spawning Prob-
lems
Changes in Fish-
ery

X X X X X X X X

Recreation Related

Traffic Jams
Solid Waste
Liquid Waste

X X X X X X X X

Unsatisfied Needs

- Flood Control
- Water Supply
- Recreation

Legend
✓ Unsatisfied
* Partially Satisfied

Other Factors

Mutually
Exclusive
Overtax Existing
Facilities

Impede Stream
Access
Poor View

Disperse
Environmental Impact

C. Recreation-Related Adverse Effects

1. Traffic jams
2. Solid waste handling
3. Liquid waste handling

In evaluating the various alternatives to the Trexler Lake project, certain of these adverse characteristics could be altogether avoided or experienced to a greatly diminished extent. The balance of this section presents alternatives to the proposed action beginning with the no-action concept and concluding with alternative actions which avoid one or more adverse environmental impacts. It should be noted at the outset that alternate multi-purpose projects providing the equivalent services were investigated in the referenced comprehensive plan for the Delaware River Basin.

b. An Alternate Multi-Purpose Project. A possible course of action would be an alternate multi-purpose project, located elsewhere of sufficient size to serve the same functions as the adopted project. Within the constraints of the plan, these projects are themselves mutually exclusive with a similar environmental impact albeit upon different sections of the river and environs. No particular environmental advantage could therefore be anticipated.

c. The No-Action Alternative. One alternative to the proposed action would be to recommend no water resource development. The major effect of this course of action would be to essentially preclude all of the adverse effects attributed to the project. It must be noted, however, that even without the project, experienced regional growth patterns would produce traffic jams and solid/liquid waste disposal problems. The demonstrated project benefits of flood control, water supply, and recreation would be foreclosed. The Trexler Project represents 1.2 percent, 3.1 percent, and 1.6 percent, respectively, of the basin needs to be met by the Delaware River Basin Plan for flood control, water supply, and recreation. Elimination of this portion of the Basin Plan would require a reevaluation of the plan to determine whether development of the remainder with or without augmentation would be meaningful in view of the extent of the basin's needs.

In view of these factors, the no-action alternative would make it impractical for future water resources development in this region. Without the project, the lands and properties downstream would still be subject to flood damage. Owing to the high degree of regional development and multitude of political subdivisions, introduction of effective flood plain zoning restriction is not realistic. In the absence of the project, the existing and future needs for water supply would have to be met by other alternatives while the need for recreation facilities would be largely unsatisfied because of lack of adequate public facilities. Furthermore, without the project, existing recreation facilities would be further overtaxed and abused.

Environmental advantages would accrue by avoiding some of the temporary eutrophication and inundation related effects. Patently, the benefits of flood control and water supply would be foreclosed. Less obvious, however, is the lack of satisfaction of the recreation objective which would result from this approach.

Increased water-related recreation capacity would be foreclosed by this no-action alternative through elimination of 1221 acres of surface water and miles of shoreline of the projected lake. At present, open-stream recreation is restricted as compared with potential lake recreational capacity.

Environmentally, it is believed that this area could commence to develop at a rapid rate since present indications show that several developers have already acquired adjacent tracts of land. Also, as a result of the development of a large industrial complex in the vicinity of Fogelsville, there will be a demand for increased residential areas to support this complex.

d. Alternate Actions Which Avoid One or More Adverse Environmental Impacts:

(1) Constant level reservoir. An alternative action employing a reduced size, constant level reservoir was explored. This alternative would avoid large drawdowns, reduce the extent of relocations, and avoid the flood protective works required. No flood control benefits would accrue from this type of development. Water supply benefits would necessarily be compromised.

(2) Reservoir development on tributary streams. Another alternative envisages a system of small reservoirs located on tributary streams. This alternative would avoid the extensive rock cut at the damsite, the flood protective works, and some loss of historical/archaeological features. This would eliminate the direct environmental impact in the fishery and the wildlife habitat of adjacent lands. In turn, the aggregate environmental impact of the system of small reservoirs would be greater than that of the proposed project and would be spread throughout the tributaries rather than concentrated at one impoundment. Such a system would be more detrimental to tributary stream fishery than the existing project. The single impoundment is more efficient and fully serves all project purposes with less detrimental effect on the regional environment.

Construction of the required number of smaller projects along with access roads and the related facilities would extend detrimental effects over a wider area and would involve ecosystems of many tributary streams. This widespread disturbance could be expected to have some effect even on the main stem of the Delaware. The coordinated operation of such a large number of projects for water supply, flood control, and recreation would itself be an extremely complex task. Liquid wastes generated at this number of remote locations would constitute an additional and dispersed environmental hazard. Drawdown to serve supplies of water and flood control purposes would limit the effectiveness of these reservoirs for optimum recreational use as well as fishery development.

In brief, a system consisting only of small reservoirs on tributary streams would have a far greater impact on the region's environment while poorly serving some of the water resource needs and failing completely to serve others.

(3) Elimination of Recreation as a Project Purpose. Elimination of the recreational aspects of the Trexler Project would eliminate transient population pollution effects, i.e., intermittent traffic jams and solid/liquid waste disposal problems. The conclusion should be compared with the continuing growth of regional visitation and associated traffic and solid/liquid waste disposal problems. Recall also that the project-introduced waste load is only a small portion of the regional waste control requirements.

Unmanaged development of summer homes, permanent residences, and recreation-oriented businesses in the project area is continuing with resultant change in present land use. Undetermined effects on the existing environment will accompany such changes, the magnitude of which will depend on the effectiveness of fragmented local controls enacted to protect the environment.

(4) Non-Impounding Structural Alternative. Loss of river basin lands by inundation and/or flood pool effects could be circumvented by a system of levees and flood walls. Pre-project free-flowing stream conditions would also be maintained at the sacrifice of water supply and recreation. Flood protection, however, could be accomplished by an extensive system of levees and flood walls. Used in lieu of the project's flood storage capacity, this alternative provides partial protection from floods. This type of structural technique when used as a general protective measure would have an adverse effect on the environment in the area of construction. Fauna would be denied free access to the river waters; aesthetics would be impaired by creating a canal-type visual appearance; traditional human access to the stream waters could be impeded and the view of the river would be impaired for extended reaches.

(5) Non-Structural Alternative. The need to avoid adverse environmental impacts led to the consideration of positive non-structural measures. The regulation of flood plain usage, supplemented with a subsidized system of regional flood insurance, would in effect redistribute but not diminish the economic losses of flooding. Such an approach, if adopted, would not eliminate the loss of life implicit in flooding and would preclude high-valued uses of the flood plain lands for agricultural or industrial development. The project benefits of water supply and recreation would not evolve from this alternative. The necessary zoning ordinances to accomplish this would be difficult to implement on a basin-wide concept. This arises because of the many local governing bodies involved in zoning. A more severe problem is extant land improvements in the industrialized portion of the Jordan Creek which could not be readily relocated.

This course of action would not provide water supply benefits or reduced flood stages in the Lehigh or Delaware Rivers. Construction of flood walls or levees would also have an adverse effect on the environment which could be greater than the proposed project. This alternative was rejected due to the high cost of protective works required over the long reach of the Jordan Creek and secondary works required in the Lehigh River. Under this alternative, recreation benefits would be limited, land acquisition costly, and necessary zoning ordinances difficult to enact.

(6) Dry Reservoirs. A series of dry reservoirs each smaller than Trexler Lake is also an alternative for flood control. In particular, this alternative avoids most inundation effects, avoids the need for levees, reduces relocation requirements, avoids congestion, avoids eutrophication potential, and avoids drawdown. To implement this alternative appears desirable, as it is a passive system; but it would nonetheless entail environmental impact. The pool capacity required for adequate protection would lead to excessive scattered land requirements in necessarily undeveloped areas. Given such land acquisition, flora and fauna would be adversely affected by periodic inundations, by drought, and discontinuous flows. Debris carried along with flood waters in floating periods would be deposited in such reservoirs leading to waste control problems. The reservoirs would also be subject to vector inhabitation. Some remaining adverse effects of this alternative would be the necessity of constructing access routes and the seasonal flooding of river lands. In addition, this alternative would entail seasonal flooding of river and streamside land and create an aesthetically unpleasing area near the dam site filled with silt and debris. It would also forego water supply and mass recreation benefits or require satisfaction elsewhere as discussed above. The consequence of foregoing a reservoir-based water supply could be alleviated by drawing upon other sources.

(7) Multiple, Smaller Impoundments. In this alternative, each individual lake would have to be large enough to supply a portion of the total water supply that one large lake would. The multi-purpose aspect will be lost if a series of smaller impoundments is constructed. The cumulative environmental impact on the smaller individual reservoirs in the same watershed would have to be at least equal to a single impoundment to achieve the same level of control. It is more likely that the support facilities of the individual impoundments and the dispersed disruption of multiple sites would be more than the same kind of disruption in a single reservoir. Flood management is not realistic. There is simply no adequate machinery to develop proper zoning or regulation through the vast reaches of the stream in unincorporated jurisdictions.

(8) Alternate Sources for Water Supply. Surface water in the quantities required to meet projected demands is simply not available from other watersheds; the water supply problem is regional. Water supply needs could be partially met by ground water supplies as well as from the Lehigh River, but would be subject to low yield during drought conditions. Ultimately, by the year 2000, it could be expected that all sources of economically

retrievable ground water supplies would be exhausted, requiring development of surface water sources of supply.

Desalinization is a potential source of unlimited water supply. However, under present non-nuclear technology, the power required to extract the water would place a burden on diminishing supplies of fossil fuel. A single desalinization plant, based on maximum daily plant outputs and related costs expected within the near future, would not approach the daily water supply output and related costs of the Trexler Lake project. The by-products from generating the required energy for desalinization would produce an additional (both thermal and air) pollution load on the environment, the precise extent of which would be undetermined prior to selecting a specific location and type of facility.

6. Relationship Between Local Short-Term Uses of Man's Environment and Maintenance of Long-Term Productivity.

The proposed project would provide public access to the project lands for recreational usage and will ultimately accommodate a total of 424,500 visitors annually of which 177,200 would be credited to directly project-related recreational development. With inclusion of the various features recommended by the U. S. Fish and Wildlife Service, the project would produce a net overall beneficial effect on the Little Lehigh River System fishery.

A short-term adverse effect, however, will be the temporary forfeiture of certain species of fish (mentioned in Section 3) made vulnerable by the transition to a lacustrine environment. These will be replaced by other types which adapt readily to the warm surface waters of the reservoir. The Pennsylvania Fish Commission will stock the lake as it will provide potential for excellent game fishing. A lake, by nature of its width and expanse, in place of a stream will accommodate a much greater number of fishermen.

The project area, encompassing an eight mile long, winding stretch of Jordan Creek, consists primarily of farmland and sporadic foliage, the equilibrium of their relative existence being determined by the adaptability of predominantly harsh terrain to agricultural employment. Generally, the land is sparsely populated and the small villages of Weidasville and Lowhill (one dozen buildings each) comprise the most intense semblance of population in the area.

Presently more than ninety percent of the land surrounding the proposed project is occupied by farm dwellings, small communities and agricultural lands. Generally, the area is experiencing a changing economy with land use expected to change from farming to permanent residential. It is recognized that even without the project, future developments within the project boundary would eventually eliminate a large portion of the present wildlife habitat and intrude upon the natural character of the area. Sub-development activity in the project lands would restrict or eliminate present recreational access to the waters and to the adjacent game lands. In its present uncontrolled flow through this valley reach, Jordan Creek cannot adequately support either the present or projected gross water and water-related needs of the basin.

Long term productivity of the proposed project would provide full public access for recreational opportunities. The project would produce an increase in sport fisherman and recreation days. It would retain the character of the project area by placing the lands in public trust. Flood control storage would reduce flood damages downstream; while water supply storage would provide low flow augmentation through maintenance of minimum daily releases.

With Trexler Lake, the properties of people living within project boundaries will be acquired in fee, creating a personal hardship and inconvenience for them. Some will rebuild; others will move away or retire. Enactment on 2 January 1971 of PL 91-646, "Uniform Relocation Assistance and Real Property Acquisitions Policies of 1971" provides increased benefits and payment for persons displaced from dwellings, farms, and businesses. Especially significant is authority to make supplemental payments to assure availability of decent, safe, and sanitary replacement dwellings.

Construction at the dam site will create a temporary intrusion of transportation facilities and public utilities. There will be some adverse short-term influence on the local tax base as a result of public land acquisition; however, general experience on other projects is that the tax base is more than recovered by construction expenditures and the influx of recreational and water-oriented commercial activities. Correspondingly, sales of boats, water skis and general recreation equipment are expected to increase.

Extensive land tracts bordering the project area have been set aside in efforts by the Commonwealth of Pennsylvania and the Lehigh-Northampton Joint Planning Commission to preserve wildlife native to the region. It is recognized, however, that future development within the project zone would eventually eliminate a large portion of the present wildlife habitat and impair the natural character of this region. The threat becomes very realistic when one considers the expected developmental needs and the proximity of the existing Allentown-Bethlehem urban area.

Provision of 548 acres of wildlife lands will be made available to the Pennsylvania Game Commission to mitigate the project-induced damage to wildlife habitat. This acreage is augmented by downstream lands which, with the dam, would now be protected from flooding.

Flood control storage would reduce flood damages on the stem below the dam by an estimated \$372,000 per year (January 1971 price levels). Flood protection afforded by the project will produce a feeling of security in the downstream populace. The short-term storage at Trexler Reservoir will contribute to flood stage reductions at the principal damage centers of Allentown, Bethlehem, and Easton, Pennsylvania. Flood-flow routing studies show that combined operations of Trexler Reservoir with Beltzville and Aquashicola would reduce the flood level experienced in 1955 at Bethlehem by two feet.

Flood damage on the Lehigh River between Allentown and Easton during the 1955 flood amounted to \$18,689,000 of which \$15,677,600 were commercial and industrial losses. In the vicinity of Allentown, some 380 acres are subject to flooding, including 300 acres occupied by commercial and industrial establishments and 80 acres of residential area. In the vicinity of Bethlehem and Freemansburg, Pennsylvania, the flooded area consists of approximately 540 acres including 150 acres of Bethlehem Steel Company plant, and over 100 acres of residential area, public parks, railroad yards, and mainline tracks.

The extent of flooding at West Easton and Easton, Pennsylvania, depends not only on flows emanating from the Lehigh River, but also on the Delaware River flows.

In the vicinity of Trexler there were no other sites found to be suitable for storage of water, a commodity for which the needs are becoming critical. Water supply storage would utilize excess river flows, which presently are discharged to the sea.

Most of the vegetation surrounding areas of intensified construction will be destroyed. Moreover, wildlife in the path of construction will be temporarily forced to a new location. It is expected, however, that the natural resiliency and adaptation of the disturbed ecological systems will help many of the construction scars recover; nevertheless, a time lag of five to ten years or longer (in certain specialized circumstances) will be required before some of the construction scars will be healed by vegetative regrowth. When rock is left as a surface material or used on shoreland, botanical recovery will be retarded or nil.

Taking Land for Public Recreation

Taking land for public recreational purposes is frequently criticized for adversely affecting the tax base of local governments and school districts.

In spite of the widespread belief that public land acquisition reduces the local tax base, some recent studies indicate an increase in land values near recreation areas. This particular report supports this view as the local tax base recovers its initial market value the year after acquisition in 12 of 15 Pennsylvania recreational development areas. Furthermore, the gain in value after five years was greater than the general trend of constantly increasing land values. This was determined by measuring land value changes in other comparable areas not subject to recreational development. 33/

While significant gains in value of land adjacent to public recreational areas have been noted, these gains have not been excessive on the average. The project will provide open space in a region which is likely to become urbanized in the future as a result of population and industrial pressure from the city of Allentown. The short and long term effect of the project would be to satisfy immediate and future water supply needs and provide recreation facilities in an area where demand for such facilities exceeds the supply. The project will tend to organize the land-use for the maximum number of participants while conserving the resource in a semi-natural state. Future technological developments in water supply and flood control technology methods and changes in recreation needs could affect the long term necessity for the project.

33/ Farm Economics, Sept. 1969, Pennsylvania State University.

7. Irreversible or Irretrievable Commitments of Resources Which Would be Involved in the Proposed Action Should It Be Implemented

With the construction of a dam across Jordan Creek at Trexler, the water level will rise spilling out over the land to form a 1220 acre lake. Jordan, Lyon, and Mill Creeks will relinquish their free-flowing qualities through portions of their length 34/, being replaced by a serene expanse of water. All unsalvageable vegetative growth within the impounded water zone will be lost. Moreover, some small percentage of wildlife in their failure to seek higher ground will be lost.

Recommendations have been made for the preservation of structures possessing historical significance through relocation and, similarly, it has been suggested that trees presently cultivated in the project area nurseries be transplanted and utilized for site beautification purposes. There are no significant stands of rare plant specimens in the project area; however, these stands do occur in other parts of the township and are being preserved and protected by county and State agencies.

Opportunity for expanded urban and agricultural development of the lake area will be foreclosed and assuredly changed land use will accompany the project.

The considerable magnitude of undertaking defined by this project does not preclude alteration or restoration by future generations. With the exception of a large permanent rock face at the right abutment and the excavation required in shaping the spillway, no irreversible or irretrievable commitments of resources other than the actual expenditure of labor and materials are involved.

Undoubtedly, changed land use will accompany this development. However, with implementation of the prepared Comprehensive Land Use Plan for the area, it is believed that a controlled, calculated commitment of these resources would prevail 35/.

34/ Total length involved aggregates 8.6 miles.

35/ Joint Planning Commission -- Lehigh/Northampton Counties, Lehigh Valley, Pennsylvania.

8. Coordination with Others
a. Public participation

The District Engineer issued a news release noting that the draft environmental impact statement had been prepared and was available to the public. The following list of individuals and organizations requested and received copies of the statement. No comments have been forthcoming from the public sector, except those from Mrs. Snyder and Miss Hertzog included on page 8-34.

Sierra Club, Phila. Chapter
Izaak Walton League of America
Lehigh University, Biology Department
Moravian College, Environmental Society
Pennsylvania Power and Light Co.
Levans Homeowners Association

Dr. Isadore Mineo
Clarence Nagler, Jr.
Edwin R. Snyder
Aaron H. Hower
Charles P. Dugan
Gertrude Fox
Jon R. Roth
Tom Kasline
Rudolph Herbst
J. Bruce Mordaunt

b. Government Agencies

The draft environmental impact statement was sent to the following governmental agencies requesting their views and comments. The comments of responding agencies are summarized below in this section; copies of the agency replies are attached to the environmental statement.

U.S. Fish & Wildlife Service
Environmental Protection Agency
U.S. Department of Housing & Urban Development
Department of Health, Education and Welfare
Bureau of Outdoor Recreation
U.S. Department of Transportation, FHA
Delaware River Basin Commission
U.S. Department of Agriculture, Soil Conservation Service
U.S. Department of Commerce
Commonwealth of Pennsylvania
Lehigh County Authority
Lowhill Township Planning Commission
Lehigh River Restoration Association
Commissioners of Lehigh County
Lehigh County Soil and Water Conservation District

Earle M. Meade
Richard W. Morgan
Robert K. Miller
Robert Wirth
Ray R. Brennen
Robert L. Gerteis
Michail Kostick
Elza Brachman
Barry Hunsicker

Joint Planning Commission,
Lehigh/Northampton Counties

Lehigh County Federation of Sportsmen's Clubs

U. S. FISH AND WILDLIFE

Comment 1

Provide dimensions, surface area of flood control land, and miles of shoreline of flood control and conservation pool.

Reply

The lake will expand to approximately 8.6 miles long at flood pool with an average width of 1500 feet. The area of the summer pool is 1310 acres and will have a shoreline of approximately 40 miles. The area of the flood control pool (EL 504) covers 1480 acres and will have a shoreline of 47 miles.

Comment 2

In Section 1d, project description should deal with the following:

(1) Predicted visitation, (2) Numbers, types and locations of recreation sites, (3) Express project acreage devoted to recreation facilities (as a percentage), (4) Expand on project sanitary facilities, (5) Give visitor information.

Response

(1) See Section 1 of the statement, (2) These are preliminary at this time, (3) Approximately 85% of the project is devoted to both active and passive recreational use, (4) Sanitary facilities will include both water borne and vault type facilities. Effluent disposal shall comply with existing Pennsylvania Department of Health and Sanitation Codes. (5) Refer to Section 1.

Comment 3

Section 1j. Fishery and Wildlife Program. Identify type of fishing to be developed, and types of wildlife.

Response

Fish management plans will be developed by the Pennsylvania Fish Commission. There will be 548 acres set aside for wildlife mitigation lands on the peninsular area bounded by Mill Creek and the Jordan Creek. Pennsylvania Game Commission will manage the wildlife area in accordance with their plans.

Comment 4

Section 2.2.e **Identify** contributors to the pollutant load and estimate annual and seasonal concentrations.

Response

The Trojan Powder Plant and the Lehigh Valley Cooperative Dairy is downstream from the project. U.S.G.S. is performing a pre-impoundment survey sponsored by the Corps to evaluate pollutants which would enter the reservoir. The Pennsylvania Department of Environmental Resources has located point sources and an attempt will be made by DER and DRBC to locate non-point sources and enforce pollution control laws in accordance with standards established by the Commonwealth of Pennsylvania and the Delaware River Basin Commission.

Comment 5

Section 2.3.g. Plant communities to be affected should be more thoroughly discussed, including unique species.

Response

See pages 1-3 and 1-4 which cover the recreation aspects. There are no significant stands of rare plant specimens in the project area; however, those stands that do occur in other parts of the township are being preserved and protected by the county and state agencies. Passive areas and internal roads and controls will be provided to eliminate traffic congestion. For the visitor use area: one of the facts used in determining the annual visitation rate considers the ability of the land to absorb visitors. Trash and litter will be removed on a daily basis.

Comment 6

Section 3.1. Further discuss permanent and temporary changes in wildlife and wildlife habitat displacement.

Response

A three year construction period is planned with one year for filling for the impoundment. The wildlife species to be found are white tail deer, cotton tails, opossum, red and grey squirrels, chipmunks, black bear, porcupine, snowshoe hare, beaver, woodchuck, bobcat, raccoons, mink, otter,

striped skunk, and muskrats. Grouse, pheasants, woodcock and water fowl are also found. Birds consist of hawks, upland plover, pileated woodpecker, snow owl, horned lark, raven; 10 species of turtles, 2 species of lizards, and 15 species of snakes are also found. Commonwealth of Pennsylvania Gamelands adjacent to the project and 548 acres of mitigation lands will accomodate upland wildlife species. Aquatic-oriented species will relocate into higher elevation aquatic habitat in the expanded impoundment shoreline. Three hundred and sixty acres of woods will be cleared in the construction and impoundment areas and will be replaced by reforestation and landscape plantings.

Comment 7

Section 3.2a. Further discuss the impact on fish and wildlife of project construction particularly regarding solid and liquid wastes and spillway erosion hazards.

Response

The flow of the stream will not be interrupted during construction or even after impoundment. Studies are under way to evaluate benefits of aquatic plant management with respect to fish habitat after impoundment. Game temporarily displaced will move to new mitigation lands provided by the project.

Liquid waste will be processed through the planned sewage treatment plant at one of the recreational areas. Liquid waste from other recreation areas will be trucked to the treatment plant for processing. Solid waste will be collected on a regular basis and disposed of offsite in a manner acceptable to local and county practices.

Comment 8

3.2.b. (3) Provide more description regarding salvagable trees and recreational use impact on the environment.

Response

Four inch to six inch caliber trees will be salvaged from the area. The numbers and species of trees available on site would be moved as required. Quantities of trees to be moved will depend on project needs: the number of available hardwood or coniferous species, the desirability of thinning a forested area or the economic feasibility of relocation versus purchase.

Litter and solid waste will be gathered and disposed of daily. Since recreational areas are planned in accordance with park standards, minimal compaction of soils should result. Some destruction of vegetation, normal to park operation, will occur. Increased sound and air pollution levels, resulting from motor boats, parking areas and public concentrations will be normal for public-use areas and minimized by vegetation and project scope.

Comment 9

3.2.c Correct sentence.

Response

Concur.

Comment 10

Section 3.3. The impact of physical changes in the environment resulting from the project should be related to effects on fish and wildlife.

Response

Environmental controls for the enhancement of fish and wildlife are put into effect during and after construction of the projects.

Comment 11

Section 4 (1). Include discussion of habitat destruction and fish and wildlife displacement effects.

Response

As the impoundment water level rises, the wildlife and fish will migrate to higher elevation to proper temperature water. In case of warm water fish species, they will remain to become part of the lake. Stream levels will be stabilized for the fishery whenever possible.

Comment 12

Section 4(2). Include adverse effects of recreational facilities, reservoir maintenance and operations on the environment.

Response

Land use change accompanied by construction scars will result. Visitor usage is calculated to be less than the land could accommodate without sustained damage.

Construction scars will be ameliorated by grading, seeding, reforestation, and landscaping will be provided as required.

Effluents from the sewage treatment plant will be properly treated under regulatory standards. Original unsanitary site conditions will be eliminated by removal of the sources within the project area. Operation and maintenance of the recreation facilities will be the responsibility of the Pennsylvania Bureau of State Parks.

Comment 13

Elaborate on mitigation design plans regarding unique plant areas, eutrophication, design capacity and socio-economic effects.

Response

There are no unique botanical areas within the project area.

The multi-level withdrawal system will minimize eutrophication of the lake waters. Oxygen delivery system may be installed if conditions of the lake warrant it.

In this preliminary stage, the material presented in Section 4 is satisfactory.

Comment 14

Section 5d (6). Discuss in more depth the "no action" alternative.

Response

The acquisition of the many downstream developments in the flood plain, including portions of suburban Allentown, is valued at many times the cost of the entire planned development of Trexler Lake.

Each individual lake would have to be large enough to supply a portion of the total water supply that one large lake would. Multi-purpose aspect will be lost if a series of smaller impoundments were constructed. The accumulative environmental impact on the smaller individual reservoirs in the same watershed would have to be at least equal to a single impoundment to achieve the same level of control. It is more likely that the support facilities of the individual impoundments and the dispersed disruption of multiple sites would be more than the same kind of disruption in a single reservoir.

Flood plain management does not totally respond to project purposes. Land use plans are being developed by State and county agencies which will provide machinery to develop proper zoning or regulation.

Comment 15

Identify the relationship between short-term use and long-term productivity. Section 6.

Response

Presently more than 90% of the surrounding the proposed project is occupied by farm dwellings, small communities and agricultural lands. Generally, the area is experiencing a changing economy with land use expected to change from farming to permanent residential. It is recognized that even without the project, future developments within the project boundary would eventually eliminate a large portion of the present wildlife habitat and intrude upon the natural character of the area. Sub-development activity in the project lands would restrict or eliminate present recreational access to the waters and to the adjacent game lands. In its present uncontrolled flow through this Valley reach, Jordan Creek cannot adequately support either the present or projected gross water and water-related needs of the basin.

Long term productivity of the proposed project would provide full public access for recreational opportunities. The project would produce an increase in sport fisherman and recreation days. It would retain the character of the project area by placing the lands in public trust. Flood control storage would reduce flood damages downstream; while water supply storage would provide low flow augmentation through maintenance of minimum daily releases.

Inflow of money would be available from the recreationists to help offset lost taxes.

Comment 16

(7) Irreversible or Irretrievable Commitment of Resources, Unique Plant communities will be lost.

Response

There are no significant stands of rare plant specimens in the project area; however, those stands do occur in other parts of the township and are being preserved and protected by county and State agencies.

ENVIRONMENTAL PROTECTION AGENCY

Comment 1

Discuss environmental trade-offs regarding the relative availability and value of land uses, particularly including:

- (1) Other comparable high quality warm water streams existing in the Jordan Basin and the Lehigh Valley.
- (2) Provisions taken for the preservation of such reaches.
- (3) Additional steps needed to preserve an ample supply of high quality water streams.

Response

Creeks within the proposed project area primarily support a warm water fishery, except for occasional deep pools of suitable habitat for trout. These streams are not stocked by the Penna. Fish Commission. The impoundment will provide an expanded fishery supporting warm water and adaptable cold water fish species. Project tailwaters will provide a significant reach for trout habitat. The agricultural value of the project lands will be abruptly lost, rather than phased-out over several years as changing land uses now indicate. The recreational and habitat values shall remain and are to be enhanced by the provision of mitigation lands, fishery stocking, recreational facilities, advanced wildlife and fishery management and an expanded shoreline contributing to increased habitat for water-oriented wildlife. Those values favorably respond to County and Townships land-use plans which include adjacent lands development controls. State and County agencies are responsible for the administration of other warm water streams beyond the project environs.

Comment 2

Discuss further enhancement of the aesthetic quality of the reservoir particularly regarding the spillway cut and the 23 foot drawdowns one year in ten.

Response

It is intended that the crown of the cut slopes on both sides of the spillway will be fenced as safety requires, and landscaped. The floor and slopes, where feasible, will be seeded with indigenous grasses. Areas subjected to drawdown exposure can be treated by grading, use of plant materials capable of withstanding community changes or enhanced to provide transitional habitat for water-oriented wildlife. Areas subject to drawdown include land managed by State Fish and Game Commissions, State Parks, Trexler Game Preserve, and the Federal Government. Those lands will be jointly enhanced and maintained.

Comment 3

Identify and correct sources of human fecal bacteria and salmonella contamination from the Trexler Game Preserve before reservoir is filled and describe the necessary steps to eliminate or disinfect such contamination.

Response

Planned public sewage systems will reduce or eliminate existing problems resulting from poorly regulated septic systems outside the project area. Land inundated by the impoundment will be cleared of vegetation and buildings and cesspool and septic tank contents removed, disinfected and filled. Nutrient source control and identification in the upstream feeder streams of the lake are coordinated on the private, local, State and Federal levels. State and County gameland management practices relate numbers of animals to land capacity resulting in reduction of nutrients from that source. Salmonella has not been identifiable in tests to-date and there is no significant fowl industry in the area. Water quality in the reservoir can be controlled by proper management practices determined when the impoundment exists and problems are specifically identified. Systematic water sampling continues under USGS auspices leading to early formulation of a pollution pattern and subsequent control program.

Comment 4

To show the level of eutrophication control due to nutrients, the results of agricultural practices and agreements with local zoning authorities and the State Department of Environment Resources to prevent accelerated development and sewage discharges upstream should be included. A systematic sampling program covering a wide range of flows throughout the year on the major tributaries of Jordan Creek upstream of the dam site should also be undertaken to settle the extent of the problem and possible treatment before construction.

Response

Regulatory agencies within the Department of Environmental Resources are responsible for and have been alerted to water quality conditions. Water sampling and quality studies are continuing with Federal and State agency coordination. Eutrophication extent is manageable and the level of management will be determined when the reservoir exists. Controls will be funded as part of normal operational and maintenance budgets.

Comment 5

Steps should be taken to upgrade the effluent discharge from upstream sewerage treatment plants before the reservoir is built.

Nutrient levels can be controlled through proper management. Local towns will properly manage their waste treatment plants in accordance with the regulations set by the various control agencies. Plant coordination and siting will comply with State regulations and regional plans for integrated waste management.

Comment 6

Secure a definite commitment from State and local authorities to preclude the danger of future treatment plants.

Response

Informal commitments from both State and local agencies indicate existing regulatory options are being incorporated into regional plans.

Comment 7

Provide details of land disposal of sewage effluent regarding effective use in a basin noted for its rapid runoff.

Response

Upgrading of area sewerage treatment facilities and planned coordinated utilization of local and Federal treatment plants obviate the need for land disposal.

Comment 8

The alternative recommendation to spray irrigation of sewage effluent of discharge into the reservoir is undesirable.

Response

Discussion of effluent treatment options of spray irrigation, discharge of properly treated effluent into the lake, and downstream discharge are offered as planning alternatives. Use of a forthcoming ecological simulation model will provide the mechanics for selection of the appropriate method.

Comment 9

Provide details concerning the location and characteristics of the disposal facility.

Response

Recreational area sewage effluent from upstream treatment plant facilities can be properly treated and discharged downstream of the dam or into the lake, if conditions permit. Operational area sewage effluents can be treated in a plant downstream of the dam in coordination with the zoo portion of the Trexler Game Preserve expansion.

Comment 10

Serious results of reservoir drawdown include;

- (1) Jordan Creek will go dry more often.
- (2) Lack of neutralizing acid from mine drainage into the Lehigh upstream of the Northhampton Co. Line.
- (3) Effects on the trout fishery due to re-entry of water from the channel of the Jordan into Helfrich's Springs area due to low flows of these streams.
- (4) Water quality in the lower Jordan is impaired by industrial discharges. Reduced flows will make attainment of the water quality objectives that much more difficult. Releases should be sufficient to insure that no portions of the stream bed become dry at any time and provide an average of 12 cfs discharge. Increased release should be provided as discussed in the USGS Report Water Resources of Lehigh County, Pennsylvania.

Response

With the 5 cfs discharge as a proposed minimum, it is expected that reaches of Jordan Creek below Trexler Lake will be dry more frequently and for longer periods of time than at present.

Jordan Creek flows are, however, not of sufficient quantity at present to have a noticeable effect on pH values in the Lehigh River.

The trout fishery in the lower reaches of Jordan Creek should not be affected since this portion of the stream is not subject to dryness but charged from local cold water spring. The USGS report (referenced in comment) indicates that water lost from Jordan Creek does not re-enter the Jordan but rather enters the Lehigh River in the vicinity of Northampton.

It is understood that release of water for dilution purposes is not an acceptable alternative to adequate treatment of industrial waste discharges.

Low flow augmentation to preclude a dry stream would constitute an enhancement of the present condition.

Comment 11

Impact statement is far too optimistic and exaggerates the potentialities of the reservoir with respect to fisheries. It is unlikely that Coho Salmon or Striped Bass could be established in the reservoir even if eutrophication did not occur. Drawdowns during the breeding season are not a very plausible way to control rough fish since a substantial investment of resources would be required. Northern Pike and Muskelunge would probably not be able to breed successfully in the reservoir. Over abundance of rough fish is almost inevitable.

Response

The potential for proper habitat and introduced species survival exists. Similar experience at Beltzville Lake shows the habitat to be desireable for the stocked muskelunge. Seining areas combined with lake drawdown may effectively control rough fish population and could be achieved by contract if that management tool is indicated. Introduction of muskelunge and pike will also help control rough fish production. Introduced species may adapt if properly stocked and controlled. Refer to comment regarding seining above. The recommendation of eliminating reservoir fluctuations is not feasible since the breeding period is also a time when drought is most likely and the minimum flow recommended might not be maintained. Fishery management is the responsibility of the Pennsylvania Fish Commission which has indicated willingness to both introduce new fish species as well as a regular stocking program and to coordinate management requirements for those and indigenous species with reservoir management. Determination of a refined program must await knowledge of temperatures, fluctuation schedules and indigenous fish quantities when the lake is operational.

Comment 12

The Corps should insure that stimulated, unplanned, secondary private development does not take place by employing its substantial local support and its contacts with state and Federal Authorities.

Response

We concur in this comment. Local government bodies will be encouraged to exercise existing controls to prevent the addition of billboards, tourist facilities, residential developments or other uncontrolled intrusions which would have an undesirable effect on the scenic vistas along the access routes. The Corps continues to coordinate efforts in this regard with local and state agencies.

Comment 13

The EIS should explain why the environmental effects are justified in terms of social and economic gains. The project purposes need to be described and analyzed and they must be shown to have a value which outweighs any inescapable environmental degradation and commitment of resources implicit in the project.

Response

The purposes of the Trexler Lake Project is adequately described in section 1 of the EIS entitled project description. The EIS should not make any attempt to justify the project with respect to environmental impacts verses social and economic benefits. The EIS should summarize and analyze the environmental effects of the alternative actions as an explanation of the recommended plan.

Comment 14

Benefits are claimed for flood damage reduction despite the fact that no systematic program is cited which would provide control over land use in the downstream flood plains.

The discussion of flood control benefits in the EIS is inadequate, particularly the degree of flood protection in downstream reaches, types of structures affected, and susceptibility to flood. Numerical benefits are based on damage estimates which are at least 10 years out of date.

Response

The flood release of the reservoir is never more than the stream capacity. Proper local zoning ordinances and land use policies emanating from incorporated political subdivisions and regional comprehensive land use plans recognize the flooding limitations and those ordinances, plans and state regulations will forestall secondary development. Damage estimates are based on the impact of the flood of record superimposed on existing and projected downstream development. The benefits cited consider current conditions. Federal agencies funding downstream development will exercise control initiatives cited in Executive Order No. 11296

Comment 15

Statement in Trexler Lake EIS 5-4 and Tocks Island Lake EIS 5-3 are alike and false.

Response

Cited statements are alike and correct. Flood protection insurance is a cost in itself and would be relieved if the regional flood protection plan, which includes both lakes and other integrated projects, is completed.

Comment 16

The purpose of the water supply storage in Trexler reservoir is not given in the Impact Statement and the tentative "justifications" advanced are fallacious on close examination.

Response

Water supply as a project purpose is discussed in the EIS. Responsibility for determining that need and advance knowledge of users is incumbent on the DRBC. That agency has agreed by resolution to purchase water from the project on behalf of the Lehigh County Water Authority. That supply source is less costly than river sources and is included as a required source in the regional water supply and sewage treatment plan. 2/

2/ Lehigh/Northampton Counties Joint Planning Commission

Comment 17

The procedure to calculate the numerical monetary benefits to be ascribed to water supply as the cost of an alternative single purpose project providing those same supplies is not correct, except where the actual value of the benefits can be shown to exceed the cost of such an alternative project. Benefits claimed are several times too large.

Response

The methodology and rationale behind the determination of the benefits is proper. Reduction in the benefits would be justified only to the extent that the various benefits are in conflict with one another. This does not apply in the relationship between flood control and water supply. Moreover, conflict between water supply and recreation benefits would occur only in the unlikely event that a drought should cause excessive drawdown of the water.

Comment 18

Use of an unrealistically low interest rate may make possible low water rates to potential users of water from the reservoir.

Response

The analysis of the project was performed at the then established rate of 3 $\frac{1}{4}\%$. As part of a sensitivity analysis, and also in accord with the annual up-dating of the project costs and benefits to reflect present prices, the analysis was performed at the current rate of 5 $\frac{1}{4}\%$ and was found to be fully justified. The water rates are determined by the DRBC, and are set in a manner to conform to the prevailing rate in the area.

Comment 19

The function which Trexler would better serve than increased withdrawals of water from the Lehigh is that of augmenting the low flows of the Lehigh and Delaware Rivers.

Response

This is not a purpose of the Project but a beneficial result of it. A result whose value is not claimed in evaluating the project justification.

Comment 20

Alternatives have not been studied, developed or described, in the case of the Trexler Lake impact statement, for the simple reason that virtually the entire alternatives section is taken over word for word from the Tocks Island Impact Statement.

Response

The Trexler Project is a small portion of a regional plan of which Tocks Island is a major part. Many of the fundamental thoughts expressed in the Tocks Island EIS are comparable to this project and the Tocks EIS was therefore used as a base in some of the Trexler project discussion. The overall plan is comprised of many Federal and State projects of both single and multiple-uses. Each project is justified in its own right. **The basic relationship of the projects is the flood control purpose of each.** Water supply is not a purpose of most of the projects and providing that capacity would involve relocation of environmental impacts from one location to another.

DEPT. OF HEALTH, EDUCATION AND WELFARE (HEW)

Comment:

The Project does not appear to represent a hazard to public health or safety

Response:

None required

DELAWARE RIVER BASIN COMMISSION

Comment 1

How were the percentages 1.2, 3.1, and 1.6 mentioned in page 11 of the Foreward determined for use in formulating the Trexler Lake project in regard to flood control, water supply storage and recreation?

Response

These percentages were arrived at using figures in the Delaware River Basin Report of the Comprehensive Plan.

Comment 2-3

Additional maps and format changes would be helpful to the reader.

Response

Format is standardized by regulation.

Comment 4

To minimize adverse impacts on aquatic life, can sudden extreme fluctuations in stream level be avoided by an adequate release or cutback program? Stream level fluctuations will seldom occur suddenly. Stream releases are planned according to meteorological predictions as far as in advance as possible expressly to avoid adverse impacts on downstream environment.

Response

Multi-Level outlets will control water releases which will minimize adverse impacts on aquatic life downstream.

Comment 5

DRBC makes no formal guarantees to anyone on water quality in the reservoir. This paragraph should be changed or deleted.

Response

DRBC and the Pennsylvania Dept. of Environmental Resources agreed on water quality standards for Jordan Creek and all its tributaries and steps will be taken to enforce these requirements for industrial, domestic and agricultural discharges into the stream.

Comment 6

For aesthetic purposes all trees, stumps, root systems, etc. should be removed within the drawdown zone.

Response

Removal of stumps and roots would disturb the soil, resulting in extensive erosion and siltation of the impoundment.

Comment 7

Reference to clean water zone should read:

"The Lehigh River clean water zone runs from the headwaters to a point four miles downriver from White Haven, Pennsylvania."

Response

Concur

Comment 8

Fish species mentioned in relation to feeding on vegetative growth are carnivorous rather than vegetarious.

Response

The herbivorous fish live on the vegetation which in turn are fed upon by the carnivorous fish species.

Comment 9

Another major water supply source may be Lehigh River at Northampton and Catasauqua.

Response

The combined Francis E. Walter and Aquashicola Dam when completed will supply a dependable yield of 80-100 M.G.D. into the Lehigh River which will be utilized by Allentown and the suburbs. As an alternate to the plan, the City of Allentown would draw 18.7 M.G.D. directly from the Lehigh River.

Comment 10

Most severe period of drought was from 1961 to 1967.

Response

Concur - correct

Comment 11

Can an earth dam assume a more natural form to blend with surrounding land forms? Possibly growth of trees and shrubs should be included on dam itself.

Response

Due to engineering constraints, this is not feasible. Trees and shrubs will be used in adjacent areas to soften the impact of the structure.

Comment 12

What kind of restorative landscaping program will alleviate sharp contrast between spillway cut and surrounding terrain?

Response

Operational features and adjacent areas will be landscaped to obtain aesthetic appeal. Group plantings of trees and shrubs will be utilized to eliminate the sharp contrast between the spillway and surrounding terrain.

Comment 13

What mitigative measures can be taken in drawdowns to avoid an adverse effect on fish spawning?

Response

Drawdowns will be regulated to consider fish spawning considerations within the lake.

Comment 14

States that reservoirs do not act as a nutrient trap, but says that phosphorous, an essential nutrient, precipitates and becomes insoluble. This is a contradiction.

Response

Reservoirs do act as a nutrient trap to some degree. Phosphates entering the hypolimnion of a lake in the presence of ferrous iron and oxygen will precipitate as an insoluble ferric phosphate and be deposited to the lake sediments. If anaerobic conditions develop in the sediment, the phosphorous can be freed and go into solution. In a normally stratified lake however, most of the phosphorous thus freed would remain in the hypolimnion. With re-introduction of oxygen during the fall overturn, most of the phosphorous would again be precipitated to the sediments. Over a period of years, the amount of phosphorous permanently accumulating in the sediments would increase while the amount liberated and made available by the fall overturn each year would approach some sort of equilibrium condition.

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ARMY ENGINEER DISTRICT PHILADELPHIA PA
LEHIGH RIVER BASIN, TREXLER LAKE, JORDAN CREEK, PENNSYLVANIA. F--ETC(U)
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Comment 15

Minimum daily flow on creek should be increased to at least 10 cfs or more

Response

Conservation water storage (and release) is not an authorized project purpose but a betterment. Such a release is not contemplated at this time.

Comment 16

A projected benefit of power is mentioned under (5) non-structural alternative. Is some sort of energy producing plant anticipated at Trexler?

Response

The reference has been corrected. There is no energy producing plant planned for Trexler.

Comment 17

Lehigh River is not mentioned as an alternate source of water supply. If it is not feasible, reasons need explanation.

Response

Maximum use of the Lehigh River for water supplies to Allentown and surrounding areas prohibits additional use for projected needs.

Comment 18

DRBC calculated that reservoir must yield 31 MGD. Corps has arrived at a minimum flow of 5cfs. If supplemental sources of water were used, yield from Trexler could be reduced, enabling minimum flow to be increased.

Response

Increase to 10 cfs is not sufficient to insure that the stream will flow over the solution cavity portion or gravel laden portion of the stream bed. U.S.G.S. studies indicate that a release of approximately 13 cfs would be required to insure a visible flow in all portions of Jordan Creek. It is noted that conservation water storage and releases are not authorized project purposes.

DEPT OF HOUSING AND URBAN DEVELOPMENT - PHILADELPHIA AREA OFFICE

Comment 1

Proposed project will not adversely affect any HUD financed project.

Comment 2

Benefits of combined flood control/recreation project far outweigh any of the adverse environmental effects of the project.

Comment 3

Concur in comments of 2 Aug 72 letter from Joint Planning Commission of Lehigh/Northampton Counties; requests that they will receive due consideration during finalization of project plans.

Response

Corps has considered the referenced planning suggestions.

FEDERAL HIGHWAY ADMINISTRATION (FHA)

Comment 1

Legislative Routes 39058 and 39057 will have to be upgraded if they are to carry the type of vehicle likely to enter the recreation areas. Access from Traffic Route 309 will be provided entirely by township roads, having an adverse effect on local gov't which will have over 50' of its land area removed from the tax rolls.

Response

Existing LR 39058 and 39057 will be inundated in the area of Jordan Creek except for 3-4 miles of the north end presently used as access to Trexler Game Preserve. That portion of the road is adequate to handle Game Preserve visitors. Access into operational areas adjacent to the Game Preserve will be from new roads designed for the purpose. Access into recreation areas will be provided from medium duty roads or better on upgraded existing or new roads.

Comment 2

Expect that all final design of legislative routes will be in accordance with PennDOT design standards. Request opportunity to review design highway as it progresses.

Response

This request will be accomodated.

~~DEPARTMENT~~
UNITED STATES OF AGRICULTURE -- SOIL CONSERVATION SERVICE

Comment 1

Establishment of permanent vegetative cover on the emergency spillway cut area would reduce both short and long term erosion.

Response

Top soil will be replaced on the emergency spillway, and it will be seeded to grass for erosion control and aesthetics.

Comment 2

Reestablishment of vegetation after construction can significantly reduce amount of sediment emitted to the stream system.

Response

Disturbed areas will be reseeding in accordance with good conservation methods. Diversions and retention dams will be implemented to cut down the degree of erosion.

Comment 3

How much Class II and I Agricultural land will be taken for the park?

Response

Grass lands that are planned for recreational use will remain in sod. Other agricultural land, in the recreational area, will be seeded with a grass mixture compatible to the area and project use. The remaining agricultural lands under cultivation will be planted with various wildlife grass mixtures and shrubs for the propagation and enhancement of wildlife. These lands will be under the jurisdiction of the Pennsylvania Game Commission.

Comment 4

More information on soils and limitations of land use should be included.

Response

Trexler Lake consists of recreation, State Game and mitigation lands. Areas outside of the project are not within C of jurisdiction. However, it is imperative that these lands be subject to strict conservation measures in order to minimize runoff and land erosion which would be detrimental to the waters of Trexler Lake. The prime responsibility for this rests with the private land owner and the Soil Conservation District of Lehigh County.

Comment 5

Statements of 10 percent occurrence (10-4) should indicate a yearly set of odds such as 10 percent chance of occurrence in any year, not once in 10 years.

Response

Concur.

U.S. DEPARTMENT OF COMMERCE

Comment 1

Discuss the possibility of providing artificial spawning areas.

Response

Additional studies pertaining to artificial spawning areas for game fish may be undertaken if warranted by the Pa. Fish Commission, the Corps, and U. S. Dept. of Interior.

Comment 2

List scientific and common names of fishes in the area.

Response

An inventory of the fish found in the area is listed in Section 2. Pool level will be maintained during the spawning season.

Comment 3

Section 3.3(c) states that 11,200 acres of land will be permanently inundated in addition to 2,525 acres now covered by existing stream.

Response

The lake waters will permanently inundate 1220 acres of land in addition to the 80 acres now covered by the existing stream.

Comment 4

The effect of the project on anadromous fish runs should be described and the plan to introduce top predators should be carefully evaluated.

Response

There are no anadromous fish in the Jordan Creek.

The Pennsylvania Fish Commission will prepare a fish management program for the lake, including possible introduction of new species, but this will not be done until the dam and lake are constructed.

Comment 5

Resolve the inconsistency regarding power facility.

Response

No power facility is planned for the project. Corrections made in the statement.

Comment 6

It would seem that debris accumulation in alternative dry reservoirs would also accumulate in the project as planned.

Response

Concur. Debris that would accumulate on the face of the dam, during flood stage, would be cleared and disposed of in accordance with Pennsylvania Department of Health Standards. This is also discussed in chapter three.

LEHIGH RIVER RESTORATION ASSOCIATION

Comment 1

Is multi-level withdrawal system for purposes of controlling water quality, quantity, DO, and temperature? Will water be released to the stream in varying amounts to maintain a constant lake elevation?

Response

Multi-level withdrawal will control water quality, quantity, DO and temperature. It also provides for downstream releases. Pool level will be maintained as nearly as possible at the top of the conservation pool.

Comment 2

Can coliform count be reduced when diluted in a major impoundment?

Response

Coliform count will be reduced by means of dilution.

Comment 3

What steps can be taken to upgrade effluent (oxygen sag) from Trojan Powder Company?

Response

This would come under the jurisdiction of EPA and the Dept of Environmental Resources of PA.

Comment 4

Addition 1 data concerning stratification in similar controlled impoundments. What are the effects of reduced DO in a stratified water body?

Response

Thermal stratification study has been made (See General Design Memorandum). Low DO at any lake level would affect fishery. Trout would not live in deep lake habitat regardless of whether an appropriate temperature is available. Multi-level release capability will insure water of acceptable quality downstream.

JOINT PLANNING COMMISSION -- LEHIGH/NORTHAMPTON COUNTIES

Comment 1

Value of recreation benefits is underestimated.

Response

The method of computation is deliberately conservative.

Comment 2

Procedures to protect the environment during construction should be included. Open Pit burning is unnecessary; materials can be salvaged; rock and masonry rubble can be put underwater to enhance aquatic environment for fishlife.

Response

F.I.S Statement indicated burning as a possibility. Rock and masonry will be used to fill in the old foundations. Surplus wood products can be chipped and distributed in areas above the impoundment.

Comment 3

Practices developed by NCS should be employed to reduce erosion and siltation during construction.

Corps should investigate possibility of obtaining all needed fill material from within pool area to avoid necessity of reverting borrow areas.

Response

Concur.

Comment 4

Fundamentally disagree that dam will allow development to occur in prior flood plain of Jordan Creek downstream of the dam. Advocate county acquisition for use as a park; however, protection of EXISTING development in the flood plain is a valid goal.

Response

Concur

Comment 5

Top paragraph should be reworded to read:

Water samples taken in 1968 in coordination with Pennsylvania Department of Environmental Resources showed high fecal and streptococcal coliform counts. This condition is probably due to improperly treated domestic sewage, livestock manure, and agricultural fertilizer runoff.

Response

Concur.

Comment 6

Major point sources of nutrients should be specifically identified and abated by PA Dept of Environmental Resources. Measures should be taken in reservoir to reduce incoming nutrients. European experiments indicate that planting certain nutrient-reducing shallow-water rushes in the reservoir is successful in reducing overall nutrient levels.

Response

Concur.

Comment 7

Reference to power generation should be deleted.

Response

Concur

Comment 8

On-site sewage treatment plant effluent should not be discharged into the reservoir itself.

Response

The present concept would entail transport of collected sewage waste to existing plants for treatment with no discharge to the Trexler pool.

Comment 9

Water supply is a major benefit of the project; withdrawal of water from somewhere else in the watershed of the Lehigh Valley to supplement with-

drawals from the reservoir should be investigated to possibly enable greater augmentation of downstream flows.

Response

This has been investigated and found unfeasible. Refer to the response to DRBC Comment 18 in this section.

FEDERATION OF SPORTSMAN'S CLUB IN LEHIGH COUNTY

Comment 1

Is multi-level withdrawal system for purposes of controlling water quality, quantity, DO, and temperature? Will water be released to the stream in varying amounts to maintain a constant lake elevation?

Response

Yes, to a certain degree. The multi-level withdrawal system provides for downstream releases in varying volumes; however, the pool level will be maintained as nearly as possible at the top of the conservation pool.

Comment 2

Question the statistic that Trexler Lake will provide 83% of 41 MGD water supply requirements of Lehigh County. Additional sources may become available apart from Trexler Reservoir.

Response

Dependable yield from the impoundment is 60cfs with a morning flow of 5cfs or 38.78 MGD in lieu of 41 MGD. Trexler will supply 94% of the water supply requirements of Lehigh County.

Comment 3

Jordan Creek has not been without visible flow since 1968.

Response

Jordan Creek goes dry for various durations of time about every third year.

Comment 4

Hassen Creek has a 7 - 10 MGD flow due to elimination of cone of depression by filling of quarries.

Response

Concur

Comment 5

The WGL water resources of Lehigh County study possible does not reflect average conditions of Hassen Creek. As cones of depression have recharred, flow has increased from 4-5 MM to 8-10 MM. As Trexler impoundment is stabilized, ground water levels and hence flow in Hassen Creek will increase.

Response

Concur.

STAN LAVIN HERITAGE

Comment

The dam should be built for water supply only, areas should be set aside for natural parkland and streams heavily urbanized areas. A dam is not the answer to every water problem.

Response

In addition to the purposes for a dam suggested in the comment, the additional benefits of flood control will be provided. Development of this project is planned to minimize adverse environmental effect to the greatest practical extent

MR. JAMES R. CONYARD

Comment

In the comments issued by EPA regarding the Draft EIS for the Trexler project, it was stated that there are essential project **changes** to be made and defect in the EIS. The Corps said it had no plans to re-evaluate the project as suggested.

Response

Subsequent to the **remarks** and suggestions offered by the local EPA **Region** III several extensive meetings were held between the EPA reviewer and the responsible Philadelphia District staff. Certain items which were admittedly unclear in the draft environmental impact statement have been **amplified** and clarified considerably. In these deliberations, the Corps, in co-ordination with the NWC and UMC, has continued to refine and improve upon the proposed Trexler Lake downstream release program for this needed Water Supply. It is noted that none of the improvements and refinements now being accomplished adversely affect the fundamental justification basis underlying the project.

TREXLER LAKE ENVIRONMENTAL
IMPACT STATEMENT
TABLE 1-2
DRAWDOWN FIGURES FOR VARIOUS U. S. RESERVOIRS 1/

	Surface Area (Acres)	Mean Depth	(Feet) Maximum	Pool Fluctu- ation (Feet)	Fish Stand- ing Crop 1b/acre	Age (Years) At time of SC (est.)
Kentucky	158,300	17	60	5	389	14
Pickwick	42,700	22	74	6	359	25
Wilson	15,930	37	108	3	303	34
Wheeler	67,100	17	58	6	365	16
Cartersville	69,100	14	54	2	277	19
Hales Bar	6,420	21	64	2	322	20
Chickamauga	34,500	17	55	6	160	20
Watts Bar	38,600	25	70	6	146	18
Fort Loudon	14,560	25	117	6	125	18
Ocoee's No. 1	1,760	47	120	15	34	49
Appalachia	1,120	52	130	15	77	16
Hiwassee	4,680	66	251	100	19	18
Melton Hill	5,720	21	70	10	93	1
Norris	34,200	60	200	60	124	22
Cherokee	19,100	41	123	60	211	17
Fort Patrick Henry	890	30	97	5	311	7
Boone	4,880	44	125	3	324	10
So. Holston	7,580	84	257	80	225	9
Watauga	6,430	89	259	100	115	10
Douglass	19,700	36	100	30	125	18
Santeetlah	2,860	55	180	45	53	31
Fontana	8,680	128	440	130	52	17
Nantahala	1,380	80	230	55	30	17

1/ Source: DRBC, 28 June 1971

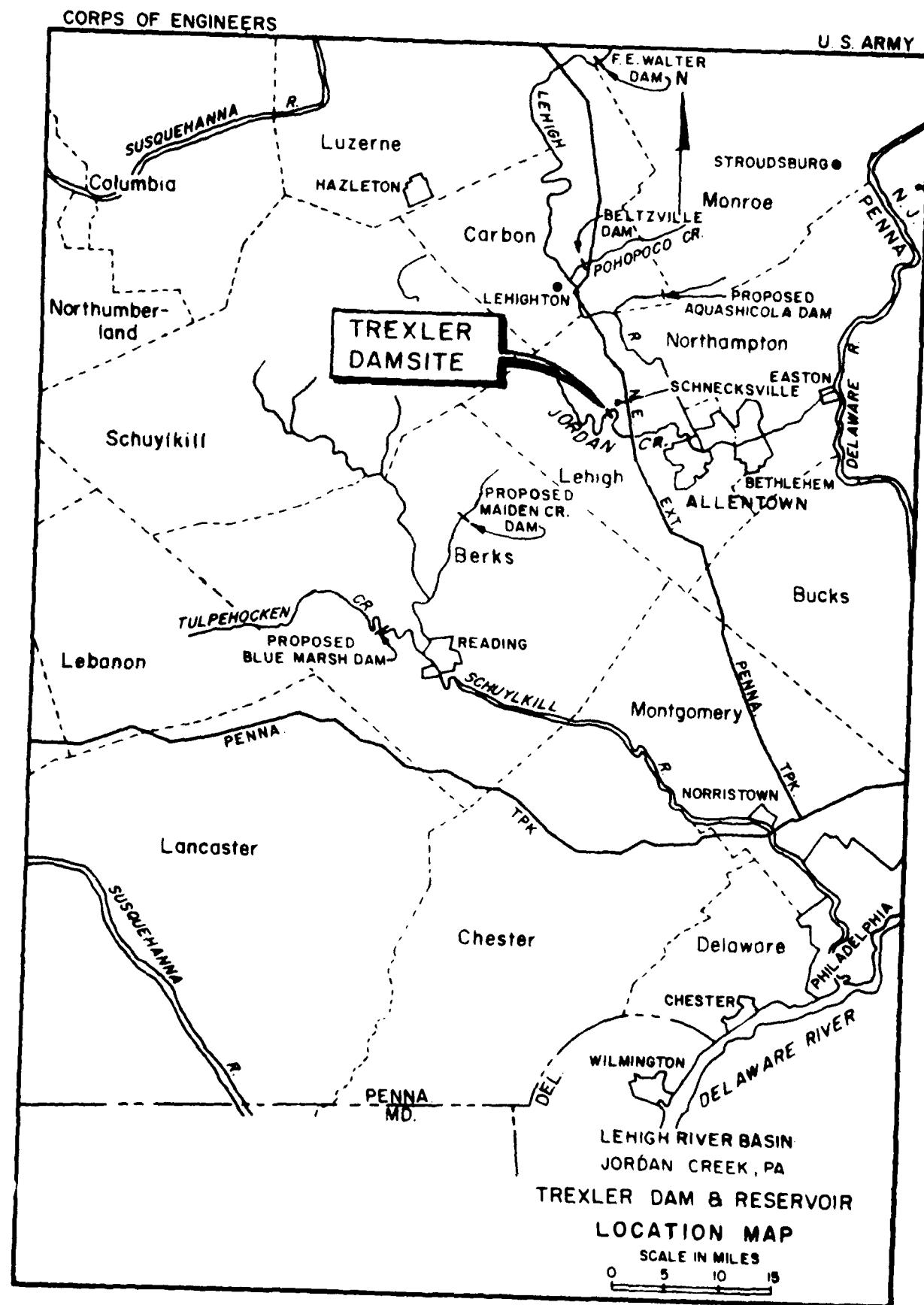
TABLE 2-2
CLIMATOLOGICAL DATA

Month	Temperature (degrees Fahrenheit)			Precipitation (inches)			Snowfall (inches)	
	Mean(1)	Max(2)	Min(2)	Mean(18)	Max(2)	Min(2)	Mean(2)	Max(2)
Jan	29.6	76	-10	3.36	6.16	0.71	8.0	23.2
Feb	30.1	73	-12	2.89	4.90	1.42	9.2	22.4
Mar	38.5	85	-5	3.52	7.21	1.39	6.6	30.5
Apr	49.9	90	20	3.75	10.09	0.64	0.5	3.1
May	60.9	95	30	3.74	7.88	0.09	T	T
Jun	69.7	102	39	3.72	6.59	0.34	0	0
Jul	74.4	103	46	4.66	8.75	0.42	0	0
Aug	72.0	102	41	4.63	12.10	1.26	0	0
Sep	65.0	102	31	3.56	7.69	1.32	0	0
Oct	54.4	93	21	3.06	6.84	0.15	T	0.2
Nov	43.3	82	3	3.21	7.83	1.00	1.0	6.3
Dec	32.0	70	-4	3.31	5.75	0.39	7.5	16.6
Annual	51.7			43.41			32.8	

(1) - Mean temperature is for 34 years of record at Allentown Gas Company.

(18) - Mean precipitation is for 53 years of record at Allentown Gas Company.

(2) - Maximum and minimum temperatures and precipitation are for 21 years of record at Allentown-Bethlehem-Easton Airport.



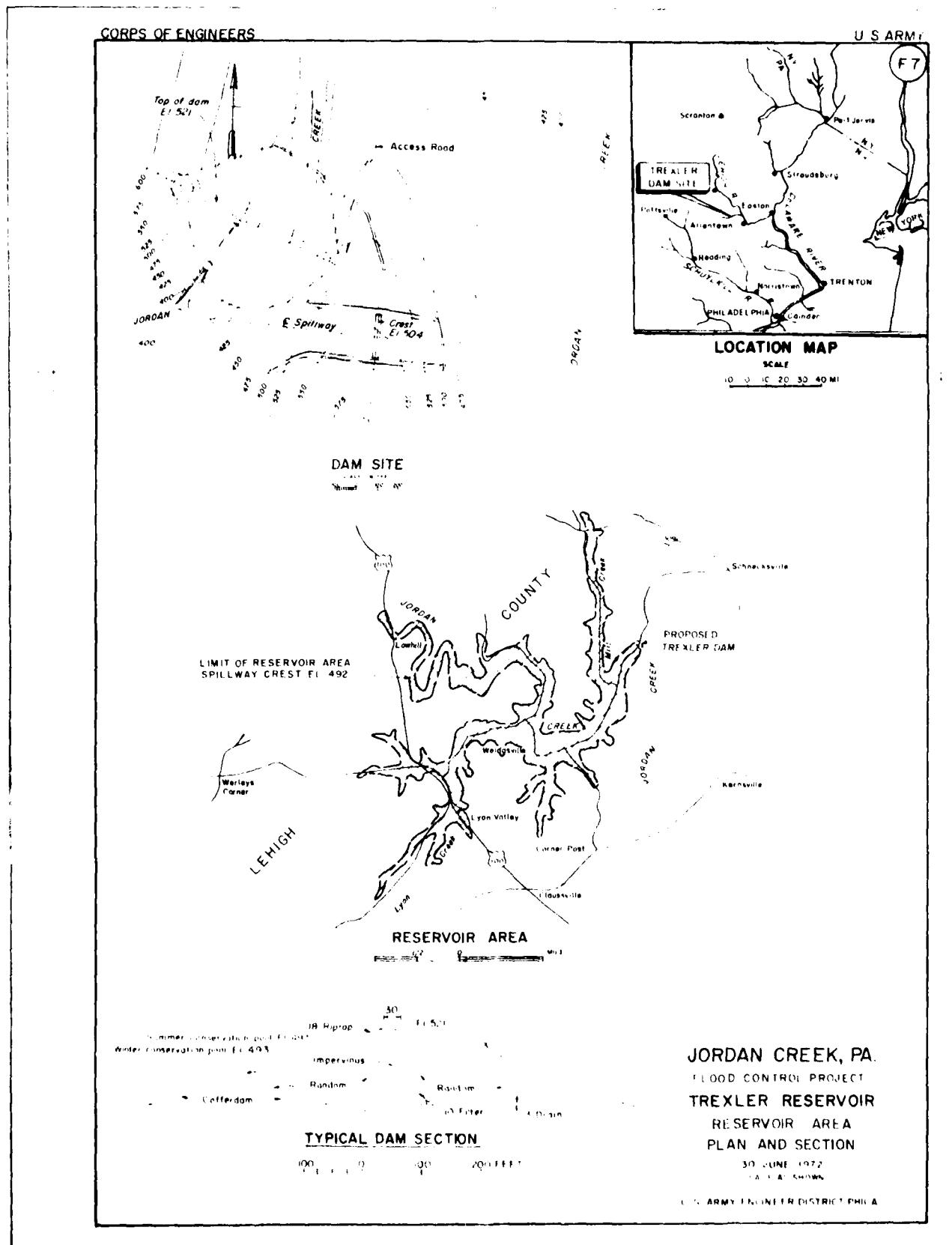
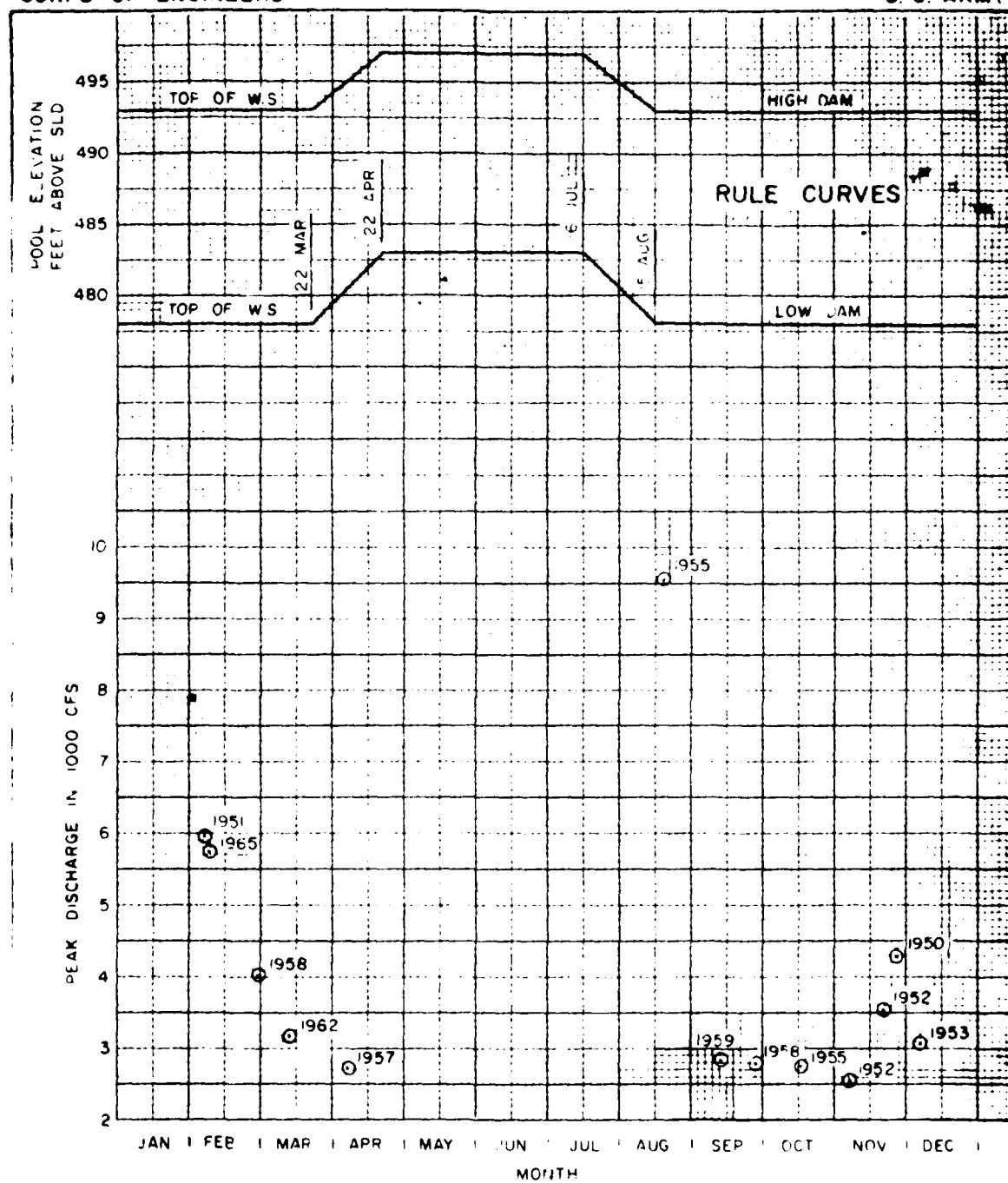


Figure 1-1(a)

CORPS OF ENGINEERS

U. S. ARMY



NOTE

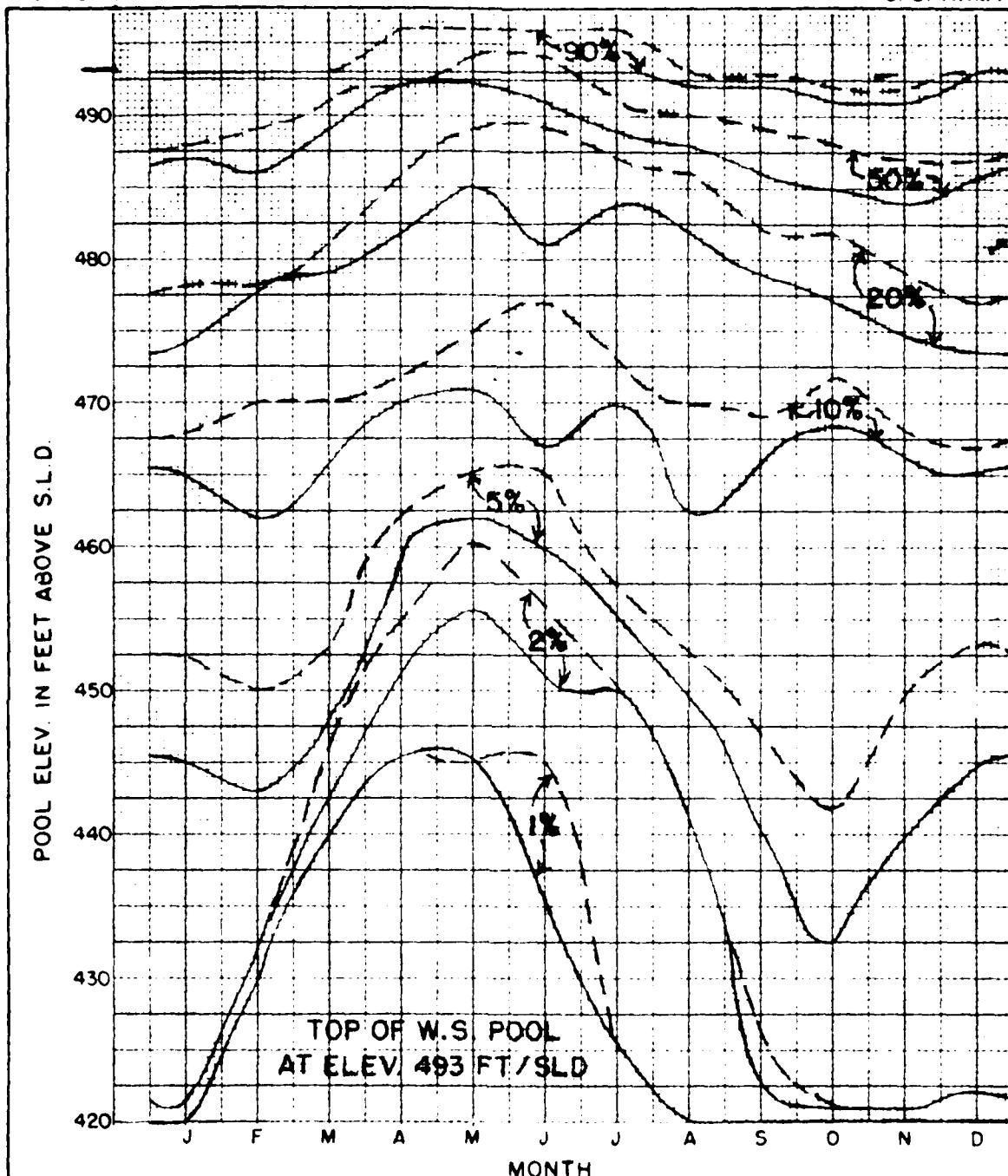
ONLY FLOODS ABOVE CHANNEL
CAPACITY (2500 CFS) ARE PLOTTED
FLOWS RECORDED AT ALLENTOWN
GAGE 1944 - 1966

LEHIGH RIVER BASIN
TREXLER RESERVOIR
JORDAN CREEK, PENNSYLVANIA
OPERATIONAL RULE CURVES AND
ANNUAL DISTRIBUTION OF FLOOD
EVENTS ON JORDAN CREEK

Figure 1-2

CORPS OF ENGINEERS

U. S. ARMY



Lehigh River Basin
TREXLER RESERVOIR
Jordan Creek, Pennsylvania
MINIMUM DAILY POOL ELEVATION PROBABILITIES BY MONTHS (HIGH DAM)

TREXLER LAKE, PENNSYLVANIA

RESERVOIR DRAWDOWN

AVERAGE ANNUAL DRAWDOWN

7 $\frac{1}{2}$ FT. 50% OCCURENCE

MAXIMUM DRAWDOWN

77 FT. 1% OCCURENCE

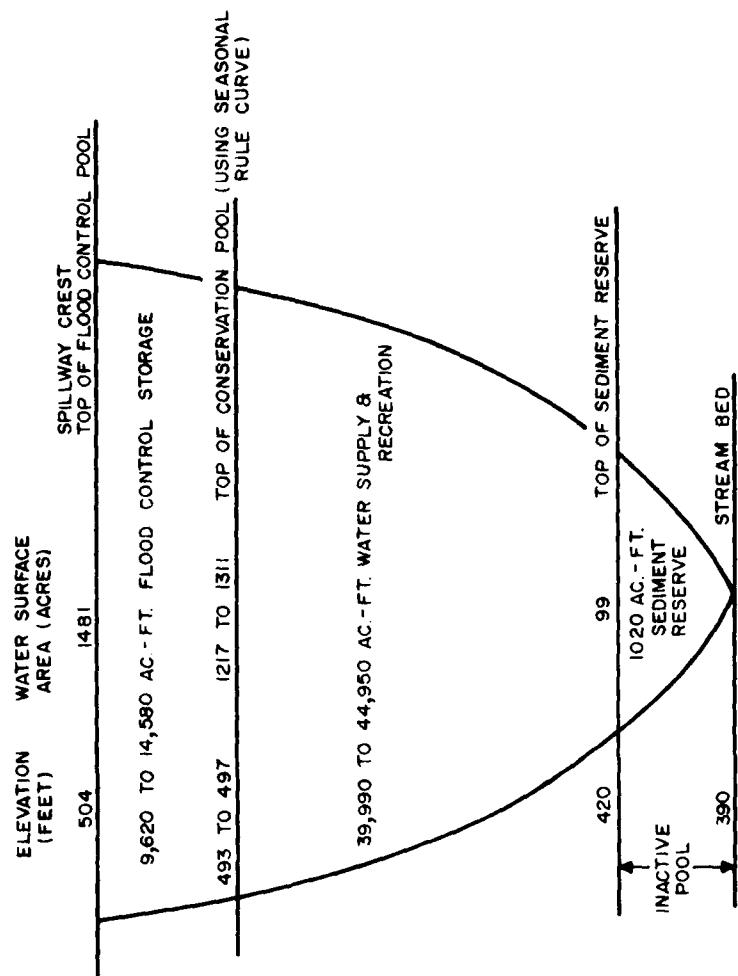
RECREATION SEASON DRAWDOWN

1 JUNE - 15 SEPT.

5 $\frac{1}{2}$ FT. 50% OCCURENCE

23 FT. 10% OCCURENCE

10% MEANS ONCE IN 10 YEARS



DIVISION: NORTH ATLANTIC

DISTRICT: PHILADELPHIA

BASIN: MIDDLE ATLANTIC

FIGURE 1-4

LEHIGH AND DELAWARE RIVER QUALITY ZONES

LEGEND

A		CLEAN WATER AREA
B		ACID MINE DRAINAGE AREA
C		RECOVERY AREA
D		DOMESTIC / INDUSTRIAL WASTE AREA
E		CLEAN WATER AREA
F		CONFLUENCE AREA

RECOMMENDED FOR APPROVAL AS THE 1961 PLANNED PREDICTIVE MAP OF THE STATE OF NEW YORK BY THE STATE PLANNING BOARD, PURSUANT TO THE REQUIREMENTS OF SECTION 100, ARTICLE 10 OF THE PLANNED PREDICTIVE MAP LAW, AND PURSUANT TO THE AUTHORITY OF SECTION 100-A, ARTICLE 10 OF THE BUREAU OF PLANNED PREDICTIVE MAPS, DEPARTMENT OF COMMUNITY AFFAIRS.

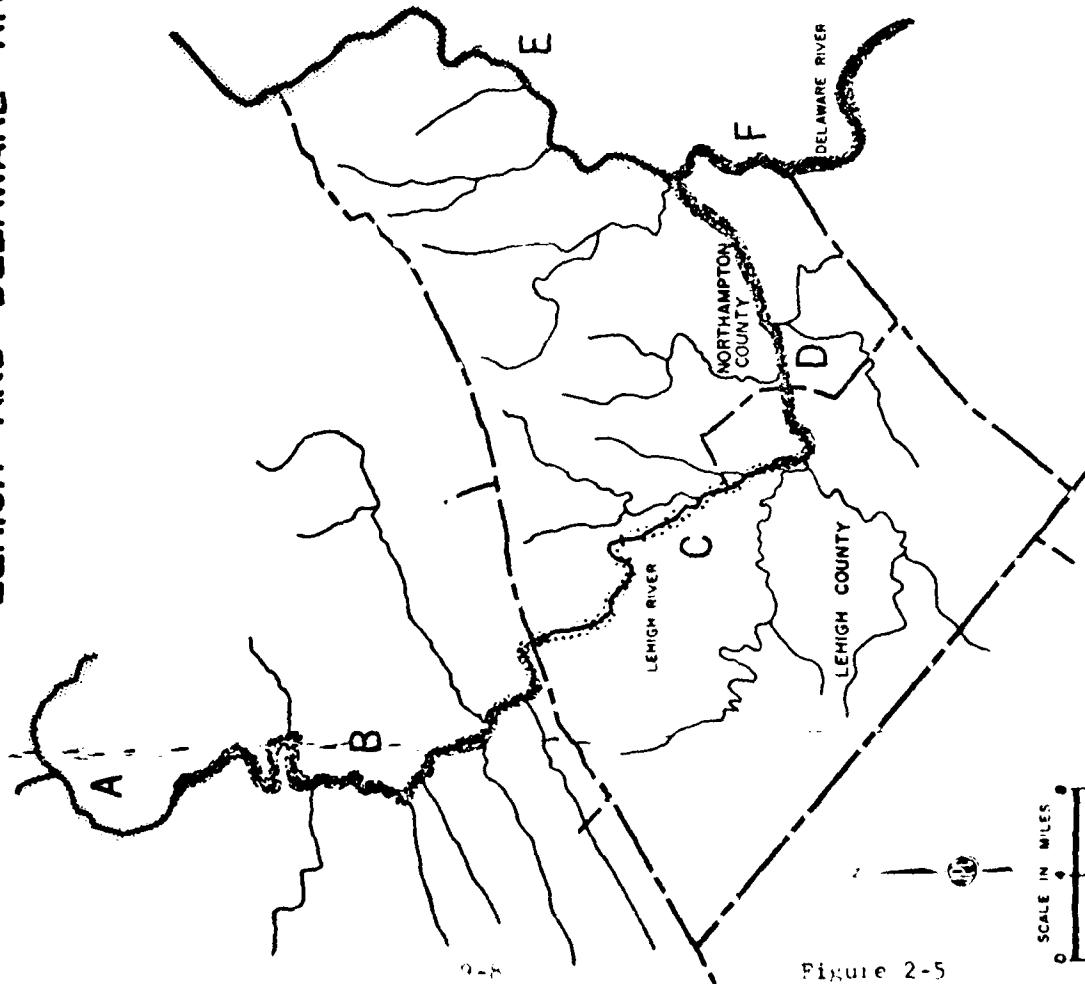


Figure 2-5

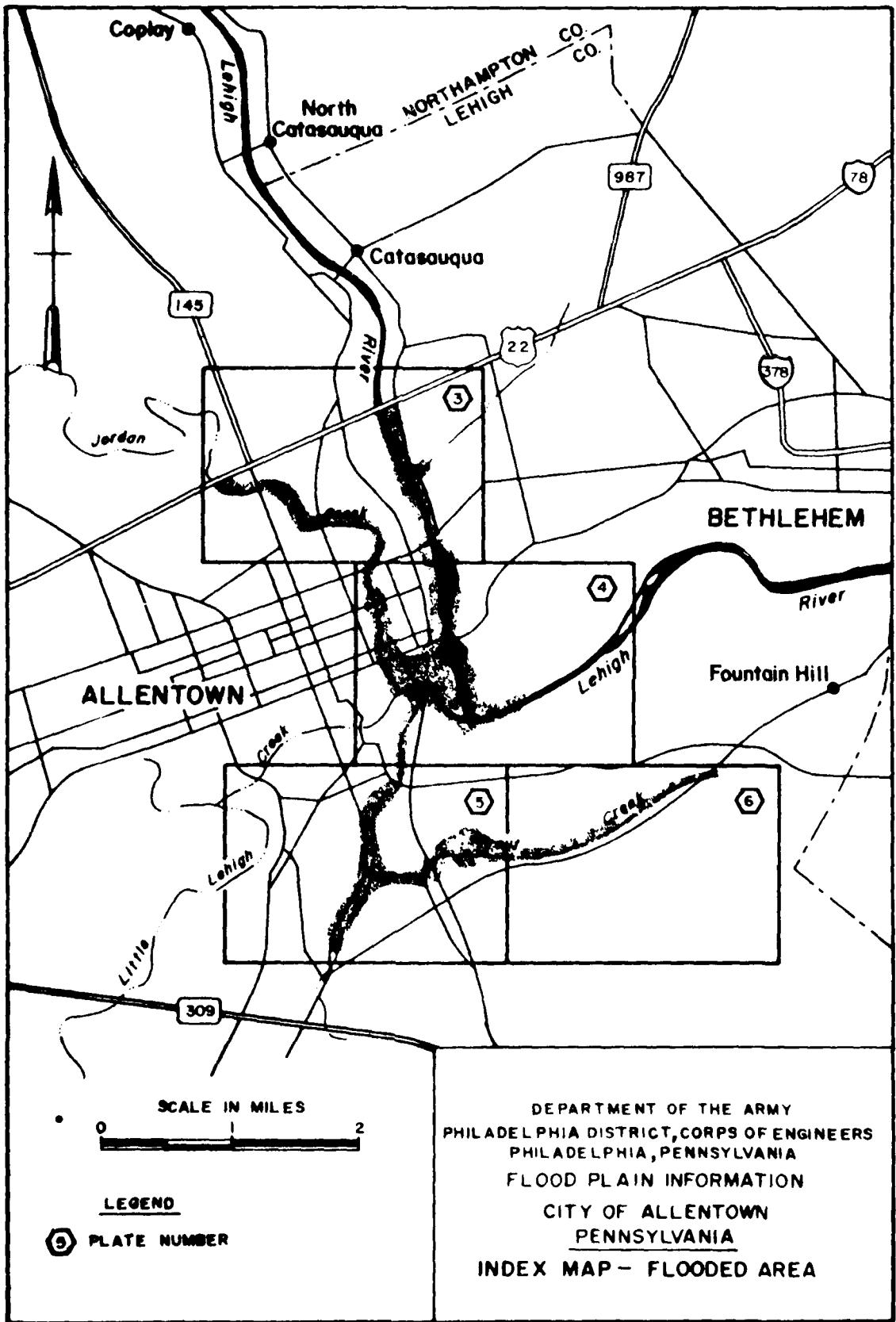


Figure 2-6

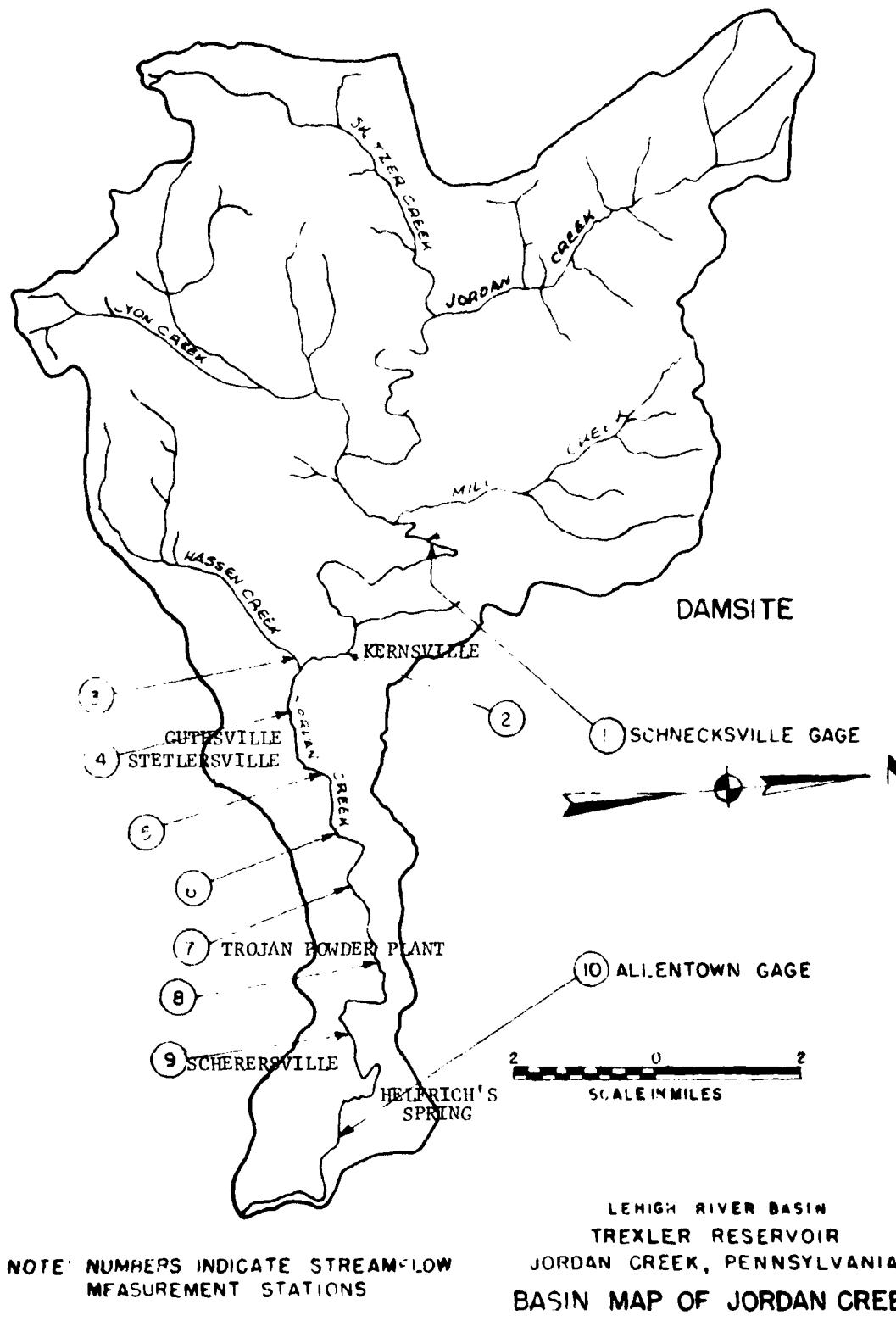
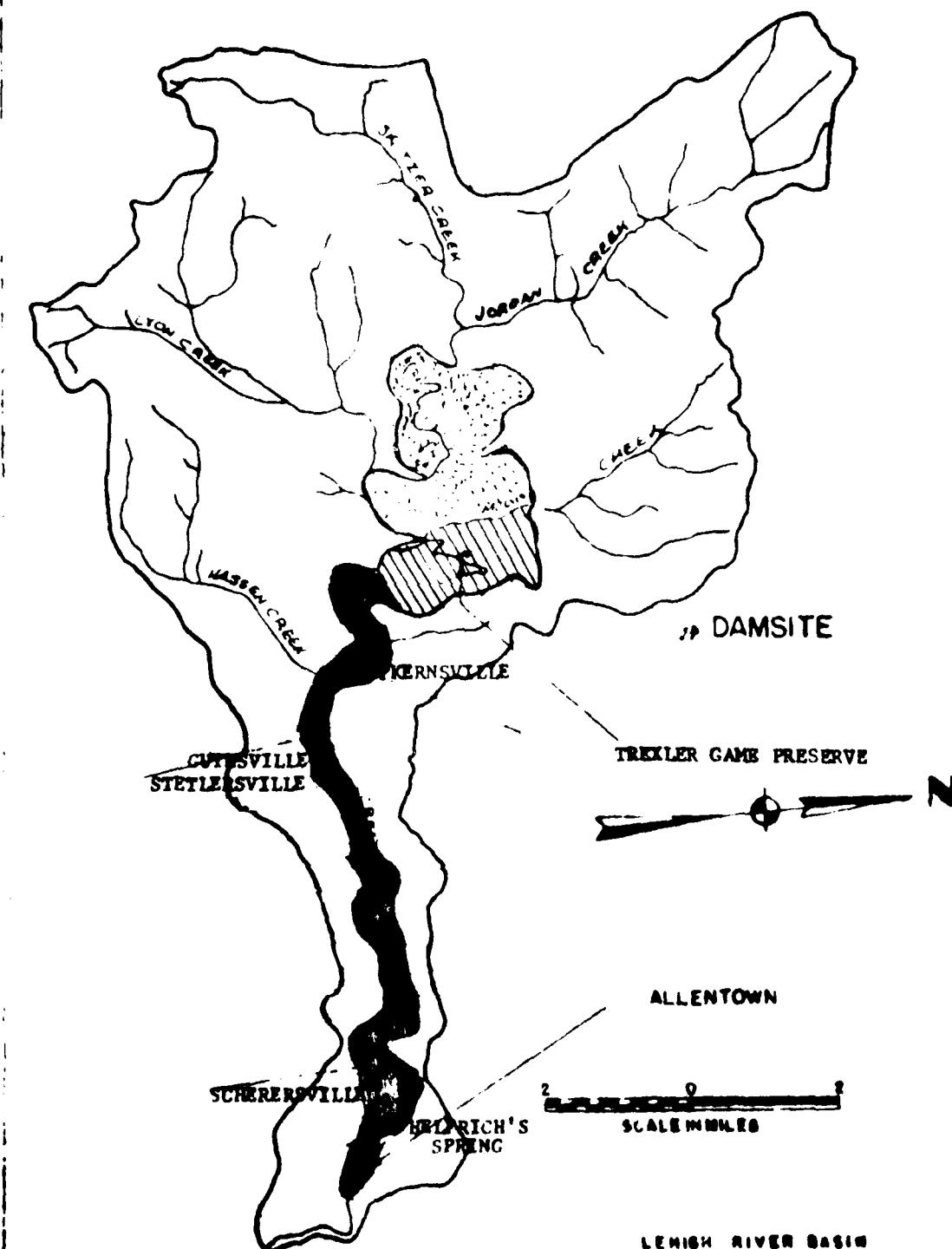


Figure 2 - 7

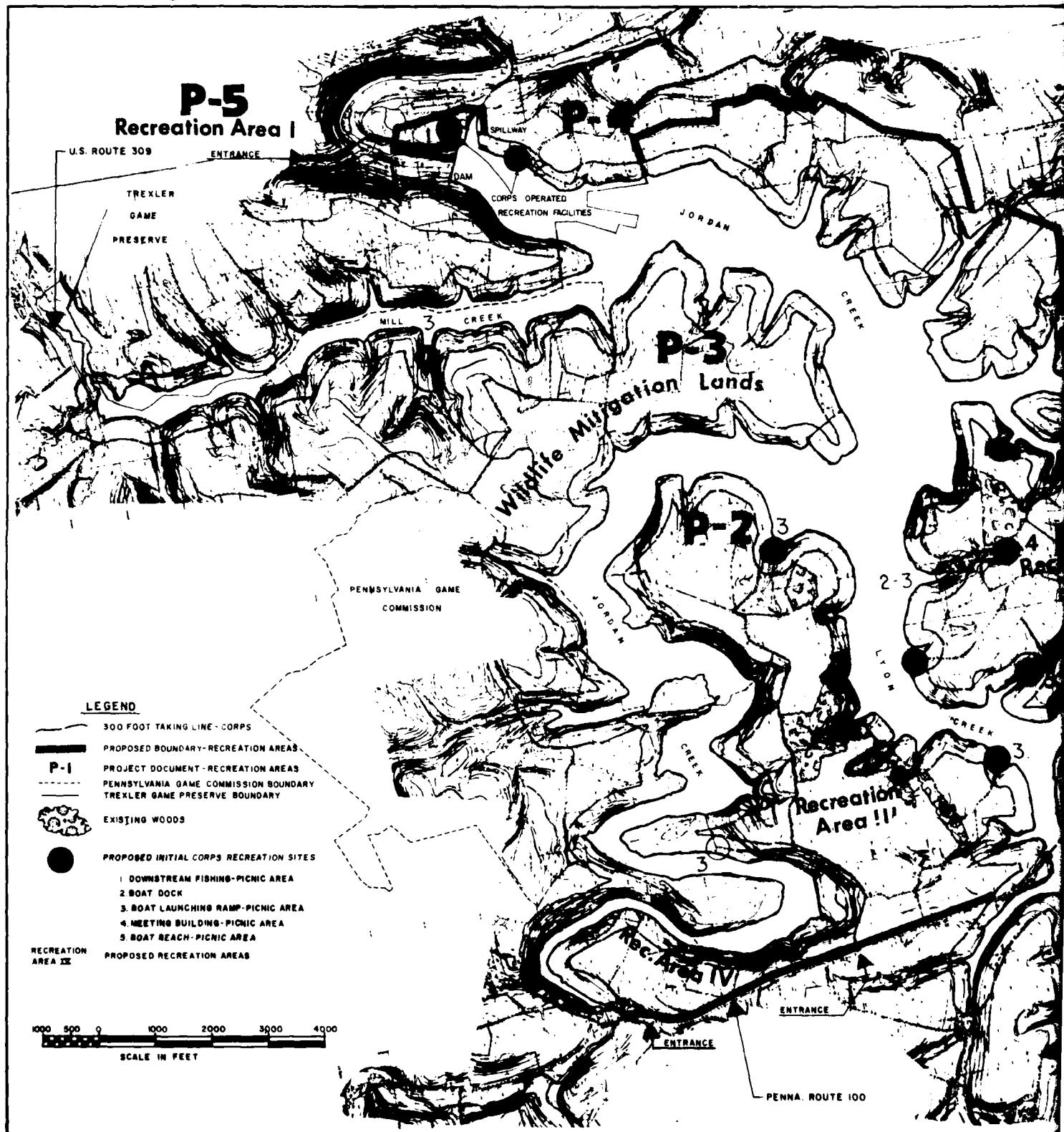
COOPS OF ENGINEERS

U. S. ARMY



- Jordan Creek County Park
- Pennsylvania State Game Lands
- Trexler Game Preserve

CORPS OF ENGINEERS



U.S. ARMY



